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A SYSTEMS ANALYSIS; A FUNCTIONAL ORGANIZATION; A CUSTOMER USERS LIBRARY (CUL)

Eunice C. Cronin

Air Force Cambridge Research Laboratories
L. G. Hanscom Field, Massachusetts

12 June 1972

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A Systems Analysis
A Functional Organization
A Customer Users Library (CUL)

EUNICE C. CRONIN

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AIR FORCE SYSTEMS COMMAND

United States Air Force

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13. ABSTRACT

A systems analysis technique is applied to the scientific problem solving requirements of a major Air Force research organization to establish: (1) the functional organization of a research support group; (2) a valuable data base for a Customer User Library (CUL); and (3) a Management Information System for scheduling, reporting and control. This report summarizes the functional organization of the Analysis and Simulation Branch of the Computation Center at AFCRL as derived from an analysis of the spectrum of analytical and computational problems originating in the Laboratories. A detailed description of the structure and mode of operation of the Customer User Library is provided, together with a discussion of the associated Management Information System. An extensive listing of scientific problem abstracts is provided in the Appendices.

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Management Information System						
Scientific Program Library						
Program Documentation						
Storage						
Retrieval						
Abstracts						
Mathematical Analysis						
Orbital Analysis						
Analog/Hybrid						
Data Reduction						
Rocket Data Analysis						
Satellite Data Analysis						

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AFCRL COMPUTATION CENTER
AIR FORCE CAMBRIDGE RESEARCH LABORATORIES
L. G. HANSCOM FIELD, BEDFORD, MASSACHUSETTS

A Systems Analysis
A Functional Organization
A Customer Users Library (CUL)

EUNICE C. CRONIN

AIR FORCE SYSTEMS COMMAND
United States Air Force

14

Abstract

A systems analysis technique is applied to the scientific problem solving requirements of a major Air Force research organization to establish: (1) the functional organization of a research support group; (2) a valuable data base for a Customer User Library (CUL); and (3) a Management Information System for scheduling, reporting and control. This report summarizes the functional organization of the Analysis and Simulation Branch of the Computation Center at AFCRL as derived from an analysis of the spectrum of analytical and computational problems originating in the Laboratories. A detailed description of the structure and mode of operation of the Customer User Library is provided, together with a discussion of the associated Management Information System. An extensive listing of scientific problem abstracts is provided in the Appendices.

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A Systems Analysis
A Functional Organization
A Customer Users Library (CUL)

1. INTRODUCTION

The Analysis and Simulation Branch of the AFCRL Computation Center is a service group which provides mathematical, analytical and programming (analog, digital or hybrid) support to the research personnel of the Air Force Cambridge Research Laboratories. It is within this service group that the Customer User Library (CUL) has been established. There was an obvious need to provide the AFCRL researcher with a service beyond the level of programming and coding; namely, a specific analytical expertise with proper liaison between him and the group performing his unique research task.

The approach taken to fulfill this need involved the utilization of a systems analysis technique which established the basis for setting the Branch's orientation along functional lines. This, in turn, dictated that the Branch organization had to be structured into five technical sections, each having its own distinct contractual support. In addition, a data base of scientific programs was established for common usage under this project-type functional organization. This data base for storage and retrieval became the Customer User Library (CUL).

(Received for publication 9 June 1972)

2. SYSTEMS ANALYSIS

Initially, four contributory areas of the overall problem were studied: the Existing Environment, the Mission, the Problems, and the Alternative Solutions.

2.1 Existing Environment

AFCRL is an organization of government laboratories conducting basic and applied research in such areas of the environment and physical sciences as: aeronomy, meteorology, ionospheric physics, radio and other astronomy, terrestial science, microwave and solid state physics. The Analysis and Simulation Branch, staffed by in-house personnel and supported by contractor efforts, is a service group to these laboratories, which must mirror the researchers' unique requirement in a systematic logic for efficient manifestation in scientific computational equipments.

2.2 Mission

The mission or objective of the Analysis and Simulation Branch is to provide quality mathematical, analytical and computational service where results have complete versimilitude; having generated the researchers' confidence in the Branch's ability, take a problem statement, understand it and present meaningful answers for their scientific research.

2.3 Problems

Assuming the Customer* can obtain efficient response from a centralized analytical service group, the myriad of other problems engendered in utilizing this type of assistance can be summed into one large one–Communication. Within this area two primary problems required solution:

(1) Establishment of effective communication between the scientist (with limited knowledge of the machinations of large computational equipments) and the Branch analyst (possessing knowledge of computational and data handling techniques –but not necessarily possessing detailed knowledge of the researchers scientific discipline).

(2) Access to all Branch expertise with a minimal time investment by the research scientist.

*Customer and researcher or research scientist are synonymous throughout this discussion of this document.

2.4 Alternative Solutions

Out of the alternative solutions reviewed, the only one to be discussed here is that which established the five functional sections of the Analysis and Simulation Branch and its data base of scientific programs.

3. FUNCTIONAL ORGANIZATION

The Analysis and Simulation Branch is organized into five sections: (1) Mathematical Analysis; (2) Orbital Determination and Operations; (3) Analog/Hybrid Analysis; (4) Non-Numeric Systems; and (5) Rocket and Satellite Data Analysis.

3.1 Mathematical Analysis (Category 1 Tasks)

This engenders those efforts where primary emphasis and facile communication is placed on the analytical formulation and mathematical solution of the problem. This area of expertise requires an advanced knowledge of: Fourier analysis, convolution, statistical analysis, ordinary and partial differential equations; discipline-oriented mathematical mapping; boundary-value analysis, complex and special functions, integral equations; integro partial differential equations; and application and development of numerical techniques to scientific problem formulations.

3.2 Orbital Determination and Operations (Category 2 Tasks)

This encompasses those tasks where primary emphasis requires a communicative knowledge of precision ephemerides of artificial or natural planetary or satellite bodies; prelaunch design of the orbit, prediction and post-launch trajectory analysis of rocket and satellite vehicles; atmospheric modelling; and geodetic parameter study support.

3.3 Analog/Hybrid Analysis (Category 3 Tasks)

This encompasses those efforts which require high-speed parallel analog processing and stored program digital processing operating in tandem for purposes of model building, simulation, optimization, or general analysis. The section operates an EAI 8900 Hybrid System. Problem efforts include vehicle simulation signal analysis, development of ionospheric research techniques, spectral analysis, filtering techniques, design optimization, and experimental data analysis.

3.4 Non-Numeric Systems (Category 4 Tasks)

This engenders those problem efforts requiring expertise in volume data handling, development of non-numeric logical techniques, and a thorough knowledge

of the operation of the computational hardware system and its inherent singularities. It includes problem areas such as contour mapping, on-line graphic techniques; and the editing, sorting and processing of raw experiment data acquired from numerous specialized equipments into useful data bases for scientific analysis.

3.5 Rocket and Satellite Data Analysis (Category 5 Tasks)

This encompasses those tasks which primarily require a knowledge of orbiting vehicles and rockets, in-flight experimental data collection, transmission and receiving.

3.6 Section Task Assignment

Once the required problem task has been delineated, it becomes the assignment of the Section Leader of primary responsibility, acting as liaison for the research scientist, to interact and acquire from all other sections within the functionally-oriented organization those additional areas of technical assistance required to perform the total problem effort. This kind of service offers the research scientist a commitment of responsibility engendered with a multiplicity of expertise in a manner offered only within a functional project environment.

4. CUSTOMER USER LIBRARY (CUL)

4.1 Purpose

One of the benefits of a functionally-oriented organization, particularly in scientific research support areas, is the delineation of those elements which are highly repetitive and/or generalized in nature and by their reusage contribute greatly to time and cost reduction. Thus, the effectiveness of the Systems Analysis technique (in establishing the need for a functional organization) would be nullified if it did not also include the provision of a common data base of information usable by all personnel of the Analysis and Simulation Branch section analysts (and the AFCRL research community as a whole).

In 1967, after twelve months of planning, the common data base, that is, the Customer User Library (CUL), was initiated. The library consists of all relevant analytical, numerical and programming tasks performed by the Analysis and Simulation Branch in-house and contractor support personnel.

CUL offers: (1) a systematic archiving of those very costly generalized efforts which can be repetitively utilized; (2) a reusable data base of specialized analytical techniques or programming methodologies which have been used for scientific application; (3) a starting nucleus for development of advanced techniques in the computational display media (that is, mathematical contouring; graphic techniques);

(4) a Management Information System encompassing elements for future statistical evaluation of the performance effectiveness in specific technical areas of endeavor.

4.2 Information Listing and Retrieval

For information purposes, all data elements of CUL may be listed by the following single parameter selection (Exhibit 5).

(1) Project Number
(2) Problem or Account Number
(3) Laboratory
(4) Company
(5) Task Initiator
(6) Author

Each of the above selected listings will contain the same information but in a different order (depending upon the readers' single-parameter selection).

Problem Number (with modification number)
Project Number
Tape Name (on which library is currently stored)
Title of Program or Analysis
Title Description
Documentation Status
Hardware
Software
Category (one of five sections of Analysis and Simulation Branch*)
Author
Company
Task Initiator
Laboratory/Branch

The data itself is retrievable by Problem or Account Number only. Since all the additional information is available on the above-mentioned listings--these two parameter selections for the data itself have proven to be quite adequate.

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*See paragraph 4.3 following

4.3 Initial Tagging for CUL

Once a problem task is brought to the Branch by a Customer, it is immediately tagged* for Section of prime responsibility and future storage to the CUL data base. All the pertinent information is extracted for management use and control as available on the Request/Authorizing form (Exhibit 1). During the performance life of this task, the problem status is available on a monthly basis until completion (See Exhibit 2).

*Category Tag	Functional Section
(1)	Mathematical Analysis
(2)	Orbital Determination and Operations
(3)	Analog/Hybrid Simulation
(4)	Non-Numeric Systems
(5)	Rocket and Satellite Data Analysis

4.4 Program Submission to CUL

When a program is completed and submitted for inclusion to the Library, it must contain an abstract of the task(s), a source deck, a source listing and memory map, compiled and executed, with a meaningful test case and a standard documentation form (Exhibit 3).

Once completed, it is submitted for testing, verification and acceptance into the CUL data base (Exhibit 4). All program submissions to CUL are validated by a "third party." This has proven to be an efficient check for impersonal, reliable verification by "other non-involved technical personnel."

4.5 Program Release from CUL

Only after validation for inclusion into the Library will a problem task (or program) be considered completed and published as such. When completed, the final "Abstract" is reviewed for publication. Upon first call for that program, the Initiator of the task is contacted for "permission to release." If received, the full package data is released to the requestor. If "permission to release" is not received (usually due to the fact the researcher has not published his final project results), a date when this is allowable is furnished the requestor.

4.6 Use of the CUL Data Base

A request to retrieve from the Customer User Library data base must be "in writing" (Exhibit 6). Statistical information for an analytical management study of library effectiveness is being accumulated (Exhibit 7). It delineates how often a given library element is requested, by whom, when requested, and when received.

5. LIBRARY ABSTRACTS

For each element of the library data base (CUL) there exists an abstract–a bibliographic data description of the scientific task and attendant information for execution on specified computational equipments. An abstract has been developed for cursory review by the potential user. Should more detail for each completed effort be required the standard documentation form (Exhibit 3) is available for perusal in the Analysis and Simulation Branch Library File. Upon written request, the entire package will be made available.

Appendix A of this report contains an Index of the Completed Problem Abstracts by Technical Key Work; Appendix B, Index by Problem Title; Appendix C, Index by AFCRL Laboratores; and Appendix D contains a copy of all Abstracts (approximately 650) currently available. This group of Abstracts represents approximately 1,000,000 source statements. As the data base expands and techniques become obsolescent, additional or revised Abstracts will be made available in future editions of this report.

6. FUTURE SYSTEMS ENHANCEMENT

At present, the Customer User Library (CUL) is operational as a batch processing system containing approximately 1400 completed programs and/or analytical efforts. A number of its "information operations" are currently being modified for on-line usage to facilitate (either by telephone request or periodic update) sending information to the research customers' building area within the AFCRL complex.

More rigorous standards for technical element subclassification, automatic selective obsolescence criteria, and modern storage media are currently being investigated.

After timely usage of the "Abstract Information" found in Appendix D of this report and the library data base (CUL) itself, a statistical evaluation of specific elements of the system will emphasize those salient areas where development of more sophisticated techniques will prove economically justifiable.

Acknowledgments

The computer program design for the Customer User Library was performed by Analysis and Computer Systems, Inc., under Contract F19628-67-C-0397 (Reference 3).

The author would like to thank Miss Suzanne Poirier for her devoted hours in the arduous pursuit of typing and retyping abstracts.

References

Armstrong, D.J., et al (1971) Analysis and Simulation Branch Scientific Problem Library. Final Report under Contract F19628-67-C-0397 (AFCRL-71-0211).

Dearden, John, McFarlan, F. Warren, and Zani, William M. (1971) Managing Computer-Based Information Systems, Richard D. Irwin, Inc., Homewood, Illinois.

McDonough, Adrian M., and Garrett, Leonard J. (1965) Management Systems, Working Concepts and Practices, Richard D. Irwin, Inc., Homewood, Illinois.

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ANALYSIS & SIMULATION BRANCH	FOR SUYA USE ONLY
REQUEST FOR	ACCOUNT NUMBER ______
MATHEMATICAL/ANALYTICAL SERVICES	PROBLEM NUMBER ______
	INITIAL REVIEW DATE ______
	SIGNATURE ______
	INITIATION DATE ______
	EST COMPLETION DATE ______

1. INITIATOR INFORMATION:

NAME: LABORATORY & BRANCH:
TELEPHONE: LOCATION:

2. PROJECT AND TASK SUPPORTED BY THIS EFFORT:

PROJECT: ☐☐☐☐☐ TASK: ☐☐ WORK UNIT: ☐☐

3. PROBLEM INFORMATION:

a. Please explain on an attached sheet all details of your problem request. If applicable, include a test case.

b. If input data is supplied on magnetic tape or punched cards, please supply full explanation of formats. If input data is not available, so state! If not available, when will it be?

4. CRITICAL TIME REQUIREMENT:

Are you requiring results for a technical paper or presentation? If so, may we know, in space below, when and/or where? By what date must you have your results? Please give meaningful information in order that the Analysis & Simulation Branch might determine how best to provide you efficient service.

5. REQUESTOR SIGNATURE: ______________ (Signature) ________ (Date)

6. AUTHORIZATION SIGNATURE:

I, by signature below, authorize the Analysis & Simulation Branch to perform the requested problem assignment. The project, task and work unit are hereby validated by me. (This authorization includes the use of the AFCRL CDC 6600 or the AFCRL Analog/Hybrid System as required.) I also certify that the Initiator is a direct federal employee.

______________ (Laboratory or Branch Chief) ________ (Date)

Effective 1 Feb 72 REGISTERED ________

Exhibit 1

LEGEND

SYMBOL	COMPANY
ACSI	Analysis & Computer Systems, Inc.
ARCON	Arcon Corporation
BC	Boston College
DABCO	Dabcovich & Company, Inc.
DPSI	Digital Programming Services, Inc.
EAI	Electronic Associates Incorporated
GC	General Computing Services, Inc.
GOV	Government
HARV	Harvard University
LOG	Logicon, Inc.
LTI	Lowell Technological Institute
MARTI	Martin Marietta Corp.
PH	Phillip Hankins & Company
RECAL	Research Calculations
RDP	RDP, Inc.
TMG	The Management Group
WOLF	Wolf Research & Development Corp.
WPI	Worcester Polytechnic Institute

Exhibit 2A

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PROBLEM NUMBER	INITIATOR	LAB	COMPANY	ISSUED DATE	COMPLETE ANALYSIS	SUBMITTED TO LIBRARY	ACCEPT DOC	DESCRIPTION
3035 01	J. GARTH	LQR	ARCON	29MAR72	01OCT72			PRED OF X-RAY PHOTOEMISSION FROM SOLIDS-ANALY SOLN
~~3035 02~~	~~J. GARTH~~	~~LQR~~	~~RO?~~	~~30MAY72~~	~~30JUL72~~			~~PRED X-RAY PHOTOEMISSION FROM SOLIDS-FIN ELE SOLN~~
3035 03	J. GARTH	LQR	SC	04MAY72	30DEC72			MONTE CARLO CALC ENERGY DEPOSITION IN SOLIDS
3036 01	R. BIRD	OPA	GOV	13JAN72	01APR72			ICE CYL RAINBOW-SUPERNUMERARIES ANAL-NUMERICAL
3036 02	R. BIRD	OPA	BC	13JAN72	01APR72	09MAY72	23MAY72	ICE CYL RAINBOW-SUPERNUMERARIES ANAL-ANALYTICAL
3037 01	R. PAPA	LZP	ACSI	01JUL71	09NOV71	26OCT71	09NOV71	SPECIALIZED INTEGRATION ROUTINES
3037 02	R. PAPA	LZP	ACSI	08DEC71	28DEC72			WAVE PROPAGATION IN A HOT MAGNETOPLASMA
~~3038 01~~	~~C. RUSH~~	~~LII~~	~~ARCON~~	~~01JUL71~~	~~31AUG72~~			~~IONOSPHERIC ANALYSIS~~
3039 01	J. JASPERSE	LQR	SC	01JUL71	31DEC71			HEAT FLOW CALCULATIONS IN LASER WINDOWS
3040 01	R. MAPLETON	LKS	RDP	01JUL71	30JAN72	28MAR72		ELECTRON CAPTURE FROM ARGON BY MULT CHARGED O+
3040 02	R. MAPLETON	LKS	RJP	01OCT71	01APR72			ELECTRON CAPTURE FROM ARGON EXCITED O+
3040 03	R. MAPLETON	LKS	RJP	08FEB72	01JUN72			ELECTRON CAPTURE K-SUBSHELL ARGON
3041 01	J. FORBES	LK3	RJP	11JUN71	30DEC71	02MAY72	04MAY72	DYNAMIC MODEL OF THE THERMOSPHERE
~~3043 01~~	~~K. THOMSON~~	~~LH~~	~~RJP~~	~~01JUL71~~	~~30DEC71~~			~~ELASTIC DISPLACEMENT VECTOR MODEL~~
3044 01	J. JASPERSE	LKS	BC	03MAR72	03JUN72			IONOSP'C ELECTN CONCENTRA TRANSPORT THEO BOLTZ SOL
3044 02	J. JASPERSE	LKS	BC	01MAY72	30DEC72			IONOSP'C ELECTN CONCENTRA TRANSPORT THEO EXACT SOL
3046 01	M. LEVINE	PHP	BC	16JUN71	15NOV71	10APR72	26APR72	ION PARTICLE MOTION
3048 01	J. WYNGAARD	LYB	GOV	04JUN71	30DEC71			OUR ANEMOMETER DYNAMICS
3048 02	J. WYNGAARD	LYB	GOV	31JAN72	01JUN72			RESPONSE OF STRUCTURE PARAMETER INSTRUMENTATION
~~3049 01P~~	~~C. FORSBERG~~	~~LK3~~	~~RDP~~	~~17AUG71~~	~~30DEC71~~			~~AUTOMATIC IONOGRAM REDUCTION (AIR)~~
3050 01	J. SANDOCK	LIJ	RJP	01JUL71	31OCT71			ION-ELECTRON PROFILE-ROCKET #AJ17.758
3050 02P	J. SANDOCK	LIJ	RDP	01JUL71	31OCT71			ION-ELECTRON PROFILE-ROCKET #AJ17 617
3050 03P	J. SANDOCK	LIJ	RJP	01JUL71	31OCT71			ION-ELECTRON PROFILE ROCKET #AJ17.602
3051 01	J. POIRIER	LZP	RC	15FEB72	01JUN72			PLASMA INDUCED TELM ANTENNA SYS RAD PATT MOD
3052 01	P. NEWMAN	LI	BC	31MAR72	01JUL72			SHORT TERM AUTOCORRELAT' OF THE F-LAYER CRIT FREQ
~~3053 01~~	~~J. KELLEY~~	~~PHI~~	[illegible]	[illegible]	[illegible]			~~ENERGETIC PARTICLES — EXPONENTIAL INTEGRAL~~
3054 01	E. BLIAMPTIS	LW4	[illegible]	25APR72	01SEP72			GEOPHYSICAL MEASUREMENT ARRAY
3055 01	S. BENDOW	LQO	[illegible]	23MAY72	[illegible]			DAMPING FUNCTION IN INFRARED ABSORPTION

Exhibit 2A (Cont)

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*3501 01	I. HUSSEY	SUFA	GOV	01JUL71	CON	26APR72		TRACE 66 DEVELOPMENT
~~3501 02~~	~~I. HUSSEY~~	~~SUFA~~	~~GOV~~	~~01JUL71~~	~~CON~~	~~31MAY72~~		ATMOSPHERIC MODELS STUDY
3501 03	I. HUSSEY	SUFA	LOG	01JUL71	01OCT71			JPL EPHEMERIS SYSTEMS I AND II
3501 04	I. HUSSEY	SUFA	GOV	01JUL71	CON	24APR72	27APR72	ECLIPSE
3501 05	I. HUSSEY	SUFA	BC	01NOV71	01APR72	24FEB72	29FEB72	1966 STANDARD ATMOS MODEL INTO ORBIT DETERMINATION
3501 06	I. HUSSEY	SUFA	LOG	20NOV71	01FEB72	11JAN72	16MAR72	COMPUTATION OF HELIGRAPHIC COORDINATES
3502 01	E. ROBINSON	SUFA	ADL	01JUL71	CON			ROCKET TRAJECTORY DEVELOPMENT
~~3503 01~~	~~A. ALMON~~	~~SUFA~~	~~GOV~~	~~15JUL71~~	~~06SEP71~~	~~27JUL71~~	03AUG71	QUICK ACCESS SATELLITE PROGRAM
3503 02	A. ALMON	SUFA	GOV	01FEB72	01AUG72			DEVELOP EPHEMERIS PROCESSING SYSTEM CAPABILITIES
*3504 01	H. ROEHRIG	SUFA	GOV	01JUL71	02JUL72	27OCT71		SET-UP AND MAINTAIN ORBITAL ARCHIVES
3505 01	J. MULLEN	LIR	GOV	01JUL71	CON			GENERATION OF LOOK ANGLES
3506 01	F. MARCOS	LKB	GOV	01JUL71	CON	10FEB72	07MAR72	PRELAUNCH DEVELOPMENT ON CANNONBALL II
3506 02	F. MARCOS	LKB	GOV	01JUL71	CON	01MAR72	07MAR72	PRELAUNCH DEVELOPMENT ON MUSKETBALL
~~3506 03~~	~~F. MARCOS~~	~~LKB~~	~~GOV~~	~~07AUG71~~	~~CON~~			CANNONBALL II EPHEMERIDES
*3508 01	J. BUCHAU	LIB	LOG	01JUL71	01JAN72	11FEB72		GEOMAGNETIC COORDINATES AND TIME
3508 02	J. BUCHAU	LIB	LOG	01JUN71	01MAR72	23MAR72	01MAY72	INVERT GEOMAGNETIC COORDINATE TABLE
3508 03	J. BUCHAU	LIB	LOG	01AUG71	01APR72	23MAR72	3[illegible]MAY72	FLIGHT TRACK
*3508 04	J. BUCHAU	LIB	LOG	01AUG71	01APR72	[illegible]MAY72		HEMISPHERE MAP PLOTTING
3508 05	J. BUCHAU	LIB	OG	01DEC71	01A[illegible]			COMPUTE & PLOT SATELLITE TRACKS
~~3508 06~~	~~J. BUCHAU~~	~~LIB~~	~~OG~~	~~01FEB71~~	~~01APR72~~			AURORAL ARCS
3508 07	J. BUCHAU	LIB	OG	01FEB71	01JUN72	[illegible]MAY72	31MAY72	ALOUETTE SATELLITE DATA TAPE CONVERSION
3509 01	G. HADGIGEORGE	LWS	GOV	01JUL71	CON	09MAR72	1[illegible]MAR72	ORBITAL DATA GENERATION FOR GEOS A AND GEOS B
3510 01	R. FILZ	PHE	GOV	01NOV71	CON			GENERATION OF EPHEMERIDES FOR A SPECIAL GRID
3511 01	J. CASTELLI	LIR	GOV	01JUL71	CON			SOLAR EPREMERIDES FOR OBSERVATORY AT SAG HILL
3512 01	R. WAGNER	LIB	GOV	01JUL72	CON			SATELLITF EPREMERIDES FOR 617(ZMUDA)
~~3513 01~~	~~C. RIKE~~	~~LIB~~	~~GOV~~	~~01JUL71~~	~~CON~~			SATELLITE EPREMERIDES ON SEV-CANADIAN SATELLITES
3515 01	H. WHITNEY	LIR	GOV	15OCT71	01DEC71			SPECIALIZED VERSION OF LOOK ANGLE PROGRAM
3516 01	C. REYNOLDS	LC	GOV	01OCT71	CON			PRELAUNCH COMPARATIVE STUDIES, ETC
3517 01	R. PHILBRICK	LKD	GOV	01JUL71	01DEC71			GENERATE EPHEMERIS FOR OV1-15
3517 02	R. PHILBRICK	LKD	GOV	01JUL71	15JUL71			NIRO ROCKET A17.895
3517 03	R. PHILBRICK	LKD	GOV	01JUL71	15JUL71			NIRO ROCKET A17.896
~~3517 04~~	~~R. PHILBRICK~~	~~LKD~~	~~GOV~~	~~01JUL71~~	~~01OCT71~~			NIRO ROCKET A07.942-18
3517 05	R. PHILBRICK	LKD	GOV	01JUL71	01OCT71			NIRO ROCKET A07 902-58
3517 06	R. PHILBRICK	LKD	GOV	01AUG71	CON			DETERMINATION OF ORBITAL PARAMETERS OV1-21
3517 07	R. PHILBRICK	LKD	GOV	28FEB72	01JUL72			ROCKET TRAJECTORY A07.161-6
3517 08	R. PHILBRICK	LKD	GOV	07MAR72	01JUL72			ROCKET TRAJECTORY A07.161-5
3518 01	K. CHAMPION	LKB	GOV	01OCT71	01JAN72			ORBIT DATA SATELLITE 5303 MUSKETBALL
~~3518 02~~	~~K. CHAMPION~~	~~LKB~~	~~GOV~~	~~01OCT71~~	~~01JUL72~~			ORBIT DATA SATELLITE 5302 CANNONBALL 2
3519 01	R. MARCISI	LKD	GOV	01JUL71	01OCT71			NIRO ROCKET A07.902-7
3519 02	R. MARCISI	LKD	GOV	01JUL71	01OCT71			NIRO ROCKET A07.902-8
3519 03	R. MARCISI	LKD	GOV	07MAR72	01JUL72			ROCKET TRAJECTORY A07 912-6
3519 04	R. MARCISI	LKD	GOV	07MAR72	01JUL72			ROCKET TRAJECTORY A07.131-3
3519 05	R. MARCISI	LKD	GOV	07MAR72	01JUL72			ROCKET TRAJECTORY A07.161-4
~~3520 01~~	~~J. ULWICK~~	~~LIJ~~	~~GOV~~	~~01JAN72~~	~~01MAR72~~			ROCKET TRAJECTORY PROCESSING NO. A17.110-3
3521 01	L. WEEKS	LKB	GOV	01JUL71	19JUL71			NIRO ROCKET A07 024-1
3521 02	L. WEEKS	LKB	GOV	01JUL71	19JUL71			NIRO ROCKET A07.024-2
3521 03	L. WEEKS	LKB	GOV	07MAR72	01JUL72			NIRO ROCKET A08.103-2
3521 04	L. WEEKS	LKB	GOV	07MAR72	01JUL72			NIRO ROCKET A07.913-6A
3522 01	R. VANCOUR	PHS	GOV	01JUL71	01DEC71			NIKE TOMAHAWK ROCKET AT8 298
~~3522 02~~	~~R. VANCOUR~~	~~PHS~~	~~GOV~~	~~01OCT71~~	~~31DEC71~~			ROCKET TRAJECTORY PROCESSING NO. A08.019-1
3522 03	R. VANCOUR	PHS	GOV	01OCT71	31DEC71			ROCKET TRAJECTORY PROCESSING NO. A07.019-2
3523 01	H. COHEN	LKB	GOV	18OCT71	31JAN72			ROCKET TRAJECTORY PROCESSING NO A07.914-1

Exhibit 2A (Cont)

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PROBLEM NUMBER	INITIATOR	LAB	COMPANY	ISSUED DATE	COMPLETE ANALYSIS	SUBMITTED TO LIBRARY	ACCEPT DOC	DESCRIPTION
4514 02	R. PHILBRICK	LKD	BC	01JUL71	01SEP71			ROCKET A07.982-5 ASPECT
4514 03	R. PHILBRICK	LKD	ACSI	01JUL71	31DEC71			OV3-6 ION MASS SPECTROMETER DATA PROCESSING
4514 04	R. PHILBRICK	LKD	BC	01JUL71	01SEP71			ROCKET AT7.896 ASPECT
4514 05	R. PHILBRICK	LKD	UC	01JUL71	01SEP71			ROCKET AT7.895 ASPECT
4514 06	R. PHILBRICK	LKD	ACSI	01JUL71	01JUL72			OV1-15 MSII NEUTRAL PROCESSING
4514 07	R. PHILBRICK	LKD	ACSI	01JUL71	01JUL72			OV1-15 MSI NEUTRAL PROCESSING
4514 08	R. PHILBRICK	LKD	ACSI	01JUL71	01JUL72			OV1-15 MSII ION PROCESSING
4514 09	R. PHILBRICK	LKD	BC	01JUL71	01JUL72	13NOV71		OV1-21 DATA REDUCTION ROUTINES
4514 10	R. PHILBRICK	LKD	ACSI	01JUL71	01JUL72	26APR72	01MAY72	OV3-6 DATA MERGE
4514 11	R. PHILBRICK	LKD	BC	01JUL71	01JUL72	09MAY72	11MAY72	OV4-21 ASPECT ANALYSIS
4514 12	R. PHILBRICK	LKD	BC	01JAN72	01JUN72			GYRO ROCKET A07.161-5 ASPECT
4514 13	R. PHILBRICK	LKD	BC	01JAN72	01JUN72			GYRO ROCKET A07.131-6 ASPECT
4514 14	R. PHILBRICK	LKD	BC	01FEB72	01AUG72			GYRO ROCKET A07.161-6 ASPECT
4514 15	R. PHILBRICK	LKD	BC	01FEB72	01AUG72			GYRO ROCKET A07.161-5 ASPECT
4515 01	S. PRICE	OPI	BC	01JUL71	01SEP71	15NOV71	22NOV71	BRIGHTNESS & POSITION OF SOURCES (PROJECT HI-STAR)
4515 02	S. PRICE	OPI	BC	01OCT71	31FEB72	06MAR72	22MAR72	UPDATING POSITIONS OF DETECTED SOURCES-PROJ HISTAR
4516 01	R. SAGALYN	LIF	ACSI	01JUL71	01OCT71			ISIS SPHERICAL ELECTROSTATIC ANALYZER EXPERIMENT
4516 02	R. SAGALYN	LIF	ACSI	01JUL71	01JUL72			AD/I-C INJUN V SPACECRAFT SEA EXPERIMENT
4516 03	R. SAGALYN	LIF	ACSI	01JUL71	01JUL72			ISIS-A LOGGING SYSTEM
4517 01	J. SANDOCK	LIJ	BC	01JUL71	01OCT71	30MAR72	04APR72	ROCKET AJ17.905-1 AMPULLACEOUS PROBE
4517 02	J. SANDOCK	LIJ	BC	01JUL71	01OCT71			ROCKET AJ17.758 ELECTRON COUNTER
4517 03	J. SANDOCK	LIJ	BC	01JUL71	01OCT71			ROCKET AJ17.617 ELECTRON COUNTER
4517 04	J. SANDOCK	LIJ	ACSI	01JUL71	01NOV71			ROCKET AJ17.617 PROTON DETECTOR DATA ANALYSIS
4517 05	J. SANDOCK	LIJ	ACSI	01JUL71	01NOV71			ROCKET AJ17.682 PROTON DETECTOR DATA ANALYSIS
4517 06	J. SANDOCK	LIJ	ACSI	01JUL71	01OCT71			ROCKET AJ17.617 TIME/DATA DISTRIBUTIONS
4517 07	J. SANDOCK	LIJ	ACSI	01JUL71	01OCT71			ROCKET AJ17.682 TIME/DATA DISTRIBUTIONS
4517 08	J. SANDOCK	LIJ	BC	01JAN72	01OCT72			Z-THETA PROBE AT3 756,AT3.759
4517 09	J. SANDOCK	LIJ	BC	01JAN72	01OCT72			LANGMUIR
4517 10	J. SANDOCK	LIJ	BC	01JAN72	01OCT72			SCINTILLATORS AT3 756,AT3 759
4517 11	J. SANDOCK	LIJ	BC	01JAN72	01OCT72			PLASMA FREQ. PROBE AT3.756,AT3.759
4517 12	J. SANDOCK	LIJ	BC	01JAN72	01OCT72			RPA AT3.756-AT3.757
4517 13	J. SANDOCK	LIJ	BC	01APR72	01JAN73			RADIOMETER
4517 14	J. SANDOCK	LIJ	BC	01APR72	01JAN73			ELECTROSTATIC ANALYZER
4517 15	J. SANDOCK	LIJ	BC	01APR72	01JAN73			RETARDING POTENTIAL ANALYZER
4517 16	J. SANDOCK	LIJ	BC	01APR72	01JAN73			PHOTOMETERS
4517 17	J. SANDOCK	LIJ	BC	01APR72	01JAN73			LANGMUIR PROBE A17.110-3
4518 01	N. SMIDDY	LIP	BC	01JUL71	30SEP71			GYROSCOPIC POTENTIOMETER - ROCKET A07.907-4
4518 02	N. SMIDDY	LIP	BC			13MAR72		RASP - ROCKET A07.907-3
4519 01	J. POIRIER	LZP	BC	22APR72	01NOV72			TRAILBLAZER II PROGRAM
4520 01	J. ULWICK	LIJ	BC	01JUL71	01OCT71	11JAN72	02FEB72	ROCKET AJ17.617 LANGMUIR PROBE
4520 02	J. ULWICK	LIJ	BC	01JUL71	01OCT71	11JAN72	02FEB72	ROCKET AJ17.906-1 LANGMUIR PROBE
4520 03	J. ULWICK	LIJ	BC	01JUL71	01OCT71	11JAN72	02FEB72	ROCKET AJ17.682 LANGMUIR PROBE
4520 04	J. ULWICK	LIJ	BC	01JUL71	01OCT71	11JAN72	02FEB72	ROCKET AJ17.758 LANGMUIR PROBE
4520 05	J. ULWICK	LIJ	BC	01JUL71	01OCT71	11JAN72	02FEB72	ROCKET AJ17.616 LANGMUIR PROBE
4520 06	J. ULWICK	LIJ	BC	01JUL71	01OCT71	28MAR72	06APR72	ROCKET AJ17.682(42) SCINTILLATOR PROBE
4520 07	J. ULWICK	LIJ	ACSI	01JUL71	01OCT71	19MAY72	24MAY72	ROCKET AJ17.617 PITCH ANGLE DISTRIBUTIONS
4520 08	J. ULWICK	LIJ	ACSI	01JUL71	01OCT71	19MAY72		ROCKET AJ17.682 PITCH ANGLE DISTRIBUTIONS
4520 09	J. ULWICK	LIJ	BC	01APR72	01JAN73			ELECTRON SPECTROMETER
4520 10	J ULWICK	LIJ	BC	01APR72	01JAN73			PLASMA FREQUENCY PROBE
4520 11	J. ULWICK	LIJ	BC	01APR72	01JAN73			PARTICLE COUNTER
4520 12	J. ULWICK	LIJ	BC	01APR72	01JAN73			ENERGY DEPOSITION SCINTILLATOR
4520 13	J. ULWICK	LIJ	BC	01APR72	01JAN73			GYROSCOPIC POTENTIOMETER FOR FOCKET A17.110-3

Exhibit 2A (Cont)

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**DOCUMENTATION AVAILABLE FOR JOB AS COMPLETED TO DATE

PROBLEM NUMBER	INITIATOR	LAB	COMPANY	ISSUED DATE	COMPLETE ANALYSIS	SUBMITTED TO LIBRARY	ACCEPT DOC	DESCRIPTION
9000 01	E. CRONIN	SUYA	NPI	01JAN67	30NOV69	31DEC69	31DEC69	HYBRID SPECTRAL ANALYSIS
~~9002 01~~	~~E. PAULSEN~~	~~LYN~~	~~GOV~~	~~31JUL71~~	~~30SEP71~~	~~30OCT71~~	~~30OCT71~~	~~SPECIALIZED SPECTRAL ANALYSIS~~
9003 01	L. WEEKS	LK3	GOV	30SEP71	30NOV71	28DEC71	31DEC71	EVALUATION OF ROCKET DATA NOISE
~~9004 01~~	E. GOOD	LK2	GOV	28OCT71	28JAN72	28FEB72	28FEB72	REDUCTION OF FILTER WHEEL RADIOMETER DATA
9005 01	E. CRONIN	SUYA	CAI	11JUN69	31OCT69	28FEB71	28FEB70	ORBITING VEHICLE SIMULATION
9005 01	E. CRONIN	SUYA	MARTI	01JUL70	30JUN71	30JUN71	30SEP71	ORBITING VEHICLE SIMULATION
9007 01	R. FANTE	LZP	GOV	24JAN72	01JUN72	07JUN72	15JUN72	ANALOG SIMULATION TRANSMIS' THR TIME-VARYING LAYER
~~9011 01~~	~~E. CRONIN~~	~~SUYA~~	~~CAI~~	~~01JUN68~~	~~31OCT69~~	~~28FEB71~~	[illegible]	~~IONOSPHERIC RAY TRACING~~
9012 01	E. CRONIN	SUYA	MARTI	01JUL70	30JUN71	30JUN71	30SEP71	IONOSPHERIC RAY TRACING
9013 01	D. KITROSSER	LK2	GOV	25MAR70	31JUL70	[illegible]	[illegible]	SPECTRUM STUDY ALUMINUM MONOXIDE

SAMPLE

Exhibit 2A (Cont)

STATUS OF PROBLEM NUMBERS AS OF

RECEIVED DATE	PROBLEM NUMBER	MODIF. NUMBER	PROJECT NUMBER	PROGRAMMER	INITIATOR	DECK NAME	DOCUMENTATION NAME	ACCEPTED DATE	CCC JOB	TAPE NAME
12/14/71	1277		8801	KAFATCL	TSIPOURAS	[illegible]	[illegible]	12/22/71	X	
12/14/71	1277		8801	KAFATCU	TSIPOLRAS	[illegible]	[illegible]	12/22/71	X	
04/06/72	1282		4643	BIRTWELL	MAZZIC	DOPLER	[illegible]	04/06/72	X	
05/26/72	1449		7663	SULLIVAN	ULNICK	[illegible]	RASP(758)	BEING PROCESSED		
04/06/72	1538		7661	TRUESDALE	[illegible]	PRIFLT	[illegible]	04/07/72	X	
03/28/72	1556		5620	ATKINSON	[illegible]	DENS	[illegible]ECTRON DENSITY	03/21/72	X	
12/16/71	1678		7663	P.FICRETTI	ULNICK	RASP	RASP(757)	01/12/72	X	
05/26/72	1634		7663	SULLIVAN	ULNICK	RASP	RASP(756)	BEING PROCESSED		
05/26/72	1685		7663	SULLIVAN	ULNICK	RASP	RASP(759)	BEING PROCESSED		
12/10/71	1688		7663	P.FICRETTI	NARCISI	RASP	RASP(982-2)	01/12/72	X	
05/15/72	1705		9631	RUBLI	BUCHAL	ICMCGRN	ICMCGRAP	BEING PROCESSED		
05/26/72	1718		[illegible]	SULLIVAN	ULNICK	RASP	RASP(818)	BEING PROCESSED		
12/16/71	1729		[illegible]	P.FICRETTI	NARCISI	RASP	RASP(982-4)	01/12/72	X	
12/16/71	1730		[illegible]	P.FICRETTI	NARCIJI	RASP	RASP(982-3)	01/12/72	X	
12/16/71	1731		7663	[illegible]FICRETTI	NARCISI	RASP	RASP(882)	01/12/72	X	
12/10/71	1732		[illegible]	[illegible]FICRETTI	NARCISI	RASP	RASP(893)	01/12/72	X	
03/10/72	1750		[illegible]	PARSCNS	ULNICK	RFIT	RFIT	03/13/72	X	
05/26/72	1751		[illegible]	SAVAGE	ULNICK	DEGCON	CCNCEG	BEING PROCESSED		
04/04/72	1755		8801	DELCREY	MCINERNEY	FNPLT	FNPLT	04/11/72	X	
12/16/71	1793		7663	P.FICRETTI	ULNICK	RASP	RASP(758)	01/14/72	X	
05/26/72	1794		7663	SAVAGE	ULNICK	RASP	RASP (682)	BEING PROCESSED		
12/06/71	1795		7663	P.FICRETTI	ULNICK	RASP	RASP(AJ17-586-1)	12/17/71	X	
04/12/72	1796		'663	SAVAGE	ULNICK	RASP	RASP(616)	04/13/72	X	
12/16/71	1797		7663	P.FICRETTI	ULNICK	RASP	RASP(617)	01/12/72	X	
04/29/72	1827		7663	DELOREY	ULNICK	ELCCUN	ELCCUN	05/08/72	X	
02/09/72	1872		5631	BHAVNANI	BUCHAL	TSCLNR	TSCLNR	03/07/72	X	

Exhibit 2B

STATUS OF PROBLEM NUMBERS AS OF

RECEIVED DATE	PROBLEM NUMBER	MODIF. NUMBER	PROJECT NUMBER	PROGRAMMER	INITIATOR	DECK NAME	DOCUMENTATION NAME	ACCEPTED DATE	CDC JOB	TAPE NAME
11/24/71	4012/01		0007	GROSSMAN	PERRY	PREREAD	GRAVITY	12/20/71	X	
11/24/71	4012/01		0007	GROSSMAN	PERRY	MERGE	MERGE	12/20/71	X	
11/24/71	4012/01		0007	GROSSMAN	PERRY	WTAPE	WTAPE	12/20/71	X	
11/24/71	4012/01		0007	GROSSMAN	PERRY	EDIT	EDIT	12/20/71	X	
01/05/72	4016/01		5631	O'BRIEN	CORMIER	DRAW	DRAW	01/12/72	X	
01/05/72	4016/01		5631	O'BRIEN	CORMIER	ABSP	ABSM	01/12/72	X	
12/08/71	4017/01		6690	DIETER	SCHWEINFURTH	MAIN	CANNONBALL	12/15/71	X	
01/17/72	4017/02		6690	DIETER	SCHWEINFURTH	MAIN	CANNONBALL-PLOTS	01/20/72	X	
03/16/72	4018/01		4642	WHELAN	BARRON	BARA	WHELU	03/22/72	X	
02/17/72	4019/01		5631	DIETER	TOMAN	CHECK	CHECK QUALITY CONTROL	07/23/72	X	
03/23/72	4019/03		5631	SMITH	CRONIN	WAYSPN	WAYSPN	UNACCEPTABLE-RETURNED		
05/03/72	4020/01		7621	DIETER	ELTERMAN	MODAT	OPT. ATTENUATION-PART-1	05/03/72	X	
05/03/72	4020/01		7621	DIETER	ELTERMAN	ATMFL	OPT. ATTENUATION-PART-1	05/03/72	X	
05/03/72	4020/01		7621	DIETER	ELTERMAN	WENNH	OPT. ATTENUATION-PART-2	05/03/72	X	
03/20/72	4020/01		7621	DIETER	ELTERMAN	MODATP2	OPTICAL ATTENUATION-HAZE	04/04/72	X	
05/22/72	4022/01		0001	WHELAN	HUSSEY	SORT	SORT/COMPLETE	BEING PROCESSED		
05/22/72	4022/01		0001	WHELAN	HUSSEY	WHELU	SORT/COMPLETE	BEING PROCESSED		
01/31/72	4501		0001	FUSCO	MCINERNEY	EPM	B+L GENERATOR	BEING PROCESSED		
10/13/71	4501/01		0001	ARSENAULT	MCINERNEY	TFRAME	RDAST	01/28/72	X	
03/10/72	4503/02		6690	PARSONS	CHAMPION	MAGPLT	MAGPLT	03/16/72	X	
03/10/72	4503/03		6690	R.FIORETTI	CHAMPION	S3OPS	S3OPS	03/10/72	X	
03/10/72	4503/03		6690	R.FIORETTI	CHAMPION	DMSPLT	DMSPLT	03/20/72	X	
03/07/72	4503/02		6690	CONNCLLS	CHAMPION	DRIVE	OCK901	03/16/72	X	
03/07/72	4503/02		6690	CONNCLLS	CHAMPION	DRIVV	MRGE901	03/17/72	X	
05/10/72	4505/01		7663	DELOREY	CONLEY	GERC	GERD	05/26/72	X	
04/29/72	4505/02		7663	DELOREY	CONLEY	GER2	GERD2	05/15/72	X	
04/29/72	4505/03		7663	DELOREY	CONLEY	GER3	GERD3	05/15/72	X	
04/29/72	4505/04		7663	DELOREY	CONLEY	GER4	GERD4	05/15/72	X	
04/29/72	4505/05		7663	DELOREY	CONLEY	GER5	GERD5	05/15/72	X	
04/29/72	4505/06		7663	DELOREY	CONLEY	GER6	GERD6	05/15/72	X	
05/22/72	4506/06		7663	CARBONE	GRIEDER	TEST	AUTOEDIT	05/22/72	X	
04/12/72	4507/01		4642	DELOREY	HAYES	LISTT	LISTT	04/18/72	X	
11/12/71	4514/09		6687	AUCLAIR	PHILBRICK	REFORM	REFORM	11/22/71	X	
11/12/71	4514/09		6687	AUCLAIR	PHILBRICK	DATARD	DATARD	11/22/71	X	
11/12/71	4514/09		6687	AUCLAIR	PHILBRICK	OV21MRG	OV21MRG	11/22/71	X	
03/10/72	4514/09		6687	PARSONS	PHILBRICK	PLT121	PLT121	03/13/72	X	
04/26/72	4514/10		6687	ATKINSON	PHILBRICK	OVPACK	OV3-6 DATA MERGE	05/01/72	X	
05/09/72	4514/11		6687	FIORETTI	PHILBRICK	BRAC	OV21PLT	05/11/72	X	
11/15/71	4515/01		0692	TRENT	PRICE	TAL	TAL	11/22/71	X	
03/06/72	4515/02		0692	TRENT	PRICE	BE	BE	03/22/72	X	
03/30/72	4517/01		7663	DELOREY	SANDOCK	AMFFRE	AMFFRE	04/04/72	X	
05/26/72	4518/02		8617	SAVAGE	SNIDDY	RASP	RASP (907-2)	BEING PROCESSED		
01/11/72	4520/01		7663	DELOREY	ULWICK	LANG	LANG	02/02/72	X	
01/11/72	4520/02		7663	DELOREY	ULWICK	LANG	LANG	02/02/72	X	
01/11/72	4520/03		7663	DELOREY	ULWICK	LANG	LANG	02/02/72	X	

Exhibit 2B (Cont)

Exhibit 3

Pages 20- 80

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Program Name: AUTOEDIT

Prepared under Contract No. F19628-70-C-0236 **for**

Air Force Cambridge Research Laboratories (AFSC)
Analysis and Simulation Branch

Contract Monitor: R. McInerney

SUYA Account Number: 4506-6

Project Number: 7663

Date: 2-7-72

Task Requested by: W. Griener

Lab: SUYA **Telephone:** 861-4333 **Date:** 10-1-71

Task Performed by: John Carbone

Company: ACSI **Telephone:** 272-5001 **Date:** 2-7-72

Task Understood & Approved by: J. Delaney James R. Delaney

Telephone: 861-2788 **Date:** 10-1-71

Contract Monitor Reviewed by: R. McInerney Robert E. McInerney

Telephone: 861-4333 **Date:** 30Mar72

TABLE OF CONTENTS

1.0

I. DOCUMENTATION REPORT INFORMATION

Totally New Effort	Yes _X_ No ___
Version	Yes ___ No _X_
Modification	Yes ___ No _X_
Program Conversion	Yes ___ No _X_
Decks Available	Yes _X_ No ___
Assembly Listing	Yes _X_ No ___
Test Case Results	Yes ___ No _X_
Dayfile Included	Yes _X_ No ___
Analysis Only	Yes ___ No _X_
Results Used in Technical Report?	Yes _X_ No ___

If yes, enter report title, author(s), date on next line.

To be used in Scientific Report for Contract F19628-70-C-0236

Results Used for Presentation at Technical Meeting? Yes ___ No _X_

If yes, enter title of meeting, place, date, etc. on next line.

____

Use the following available space for any additional information pertinent to this report.

2.0

II. REVISION

Revision Number: N/A

Revision Problem Number:

Revision Date:

Documentation Form Pages Affected by this Revision.

Please use the remaining space to indicate specific changes made to the program.

III. LIST OF ILLUSTRATIONS

NOTE: Illustrations may appear anywhere in text or grouped together before Appendix.

IV. INTRODUCTION

"Autoedit" is a graphics program which enables a user to display, analyze and edit a file of data interactively, as well as to obtain CRT plots of selected portions of the entire data file.

"Autoedit" can fit polynomial curves of degree 1-9 to a set of from 2-200 data points, add points to a display, delete points from a display and the data base, smooth portions of the data, and perform varied display oriented functions.

"Autoedit" also enables the user to choose X and Y values from any word or words in the logical input record.

"Autoedit" allows the user to define, interactively, the limits for each subset of his data base which is to be displayed.

"Autoedit" enables the user to create a new data file, in the same format as his original file, comprised of the results of the user's editing and smoothing.

"Autoedit" allows the user to examine a selected portion or the entire data file he has attached.

Please be concise and not over one page in length. Should cover these topics, when applicable:

1. Any relevant background on the purpose of the program.
2. What program does, not how it is done.
3. Possible expansion, modification or other uses for the program.
4. Other relevant information, such as program limitations, timing limitations, environment limitations, etc.

Operating Instructions

Throughout this document, several terms will be used which may not be familiar to the user. A brief definition of these terms follows:

1.	LIGHT-PEN	a mechanism attached to the display console which resembles a ball point pen in appearance.
2.	BUTTON	a word or words on the display screen which, when selected with the light-pen, cause a specific task to be executed.
3.	SELECT	means point the open end of the light-pen at the object to be selected. Depress the chrome switch near the end of the pen until it clicks; then release it.
4.	TASK	a set of instructions designed to perform a series of related operations.
5.	ENTER	the user enters values via the alphanumeric keyboard when required, and terminates the value being entered by typing in the character "slash" (/).

The user specifies which task to execute as well as the order in which they are to be executed by selecting the buttons with the light pen. Each button has one task overlay assigned to it.

4.2

The reader should be familiar with the contents of the "CONTROL DATA 6000 SERIES 274 INTERACTIVE GRAPHICS SYSTEM, VERSION 2". It contains a summary of software operation and external characteristics. Without knowledge of this material, the reader may have difficulty understanding the function of the following routines which are used throughout AUTOEDIT:

1) AELOUT
2) AETSKC
3) AETSKR
4) DMGET
5) DMGTBD
6) DMINIT
7) DMRLBD
8) DMSET
9) GIABRT
10) GIANE
11) GIANS
12) GIBUT
13) GICNJB
14) GICOPY
15) GIDISP
16) GIEOM
17) GIERAS
18) GIMASK
19) GIMOVE
20) GITCOP
21) GIPCON
22) GUAN
23) GURSET
24) GUSEG
25) GUSEGA
26) GUSEGI
27) GUSEGS.

V. FUNCTIONAL DESCRIPTION

Primary Buttons

There are seven primary buttons. These seven buttons are always present on the screen. When any one is selected, the secondary buttons associated with it are displayed. Primary buttons have from 0 to 6 secondary buttons each.

Primary Button	Secondary Buttons
1. PLOT	PRODUCE PLOT CHANGE HEADING
2. READ	PROCEED TO NEXT FRAME CHANGE KEYWORD OR X-Y PAIRS
3. EDIT	SMOOTH ADD POINTS DELETE POINTS REPEAT FACTOR CONNECT DISCONNECT
4. SEGMENT	CHANGE X-AXIS CHANGE Y-AXIS DISPLAY ORIGINAL DATA SAVE CURRENT DATA
5. FIT	no secondary buttons
6. STOP	no secondary buttons
7. RESET	no secondary buttons

In addition to the secondary buttons displayed, the button RETURN TO MAIN MENU is also displayed when any primary button is selected.

General explanation of what program does and how it is done. Something about input and output of program and action taken by program. Attach FLOW CHART and PROGRAM LEGEND when applicable.

The RESET button performs the function of clearing the current display from the screen and transferring control to the secondary button, "CHANGE KEY WORD OR X-Y PAIRS" (see below).

The reset button should be selected whenever a "GIDISP BUFFER OVERFLOW" error message appears at the top of the screen. RESET will clear the screen and recover from the error. The user should then wait for the message, "KEY DONE X-Y VALUES" and continue by selecting one of these three buttons.

Operation of the Program Buttons

It is by selecting secondary buttons that the user specifies the actions which the computer will perform. Following is a list of the secondary buttons and a description of the overlay associated with each one.

Produce Plot

This button produces a CRT plot of the data contained in the X and Y arrays. See "PLOTTED OUTPUT" for details of the plot. The message "Producing Hard Copy" will appear on the screen and remain until the task is completed. The user should wait for this message to disappear.

Change Headings

A line containing 50 spaces will appear on the screen. The user can enter characters into these spaces by typing them on the alphanumeric keyboard. The character "/" is used to terminate the message. This heading will now appear on all plot frames until changed by another selection of this task.

Proceed to Next Frame

When selected, this button causes logical records to be read from the user's permanent file. The "key word" in each record is checked to see if its value has exceeded the sum of the original value plus the range of the key word. See below for details of these values.

3.2

Change Key Word or X-Y Pairs

When this button is selected, three secondary buttons are displayed. They are KEY, X-Y VALUES and DONE.

The selection of "KEY" allows the user to specify the word within the logical record which is to be the key word. This must be done before any reading of data can commence. The user must also specify a starting value for the key word and a range for the key word. Initially, the data file is searched for a record whose key word value is greater than or equal to this starting value. Then, this record and all records whose key word value is less than the sum of the starting value and range are read into the program's temporary data file. This reading does not begin, however, until "DONE" is selected.

When the user selects "X-Y VALUES", he first specifies the number of (X,Y) pairs contained in each logical record. He then lists the word(s) which contain the X values, separated by commas if there are more than one. The same is done for the Y values. Each logical record must contain an equal number of X and Y values.

After specifying the number of Y values contained in each record, the user selects the type of Y-axis desired. It is important to note that a logarithmic Y-axis should be used only when the Y values vary by less than 10.0 units from minimum to maximum. The program assumes the Y values are base 10 logs. It does not calculate the logs of linear values. If the range is greater than 10.0, a display error may occur. There are no restrictions on the size of Y values if the linear Y axis is chosen.

By selecting "DONE", the user signals to commence processing of the data he has just specified.

Repeat Factor

By selecting this button, the user can change the frequency with which his data points will be displayed. Repeat factor = 1 means every point is to be displayed; RF = 2 means every 2nd point, etc. While every nth point may be displayed, every point still resides in the data file.

Smooth

This button calls into execution a task which replaces each Y value with the average of the N surrounding Y values. Thus, if N is specified as 3, for each point, the Y values of the preceding point, the following point, and the point itself are averaged. If N = 5, then the Y values of the two preceding points, the two following points and the point itself are averaged. If there are not enough preceding or following points in the set being displayed, the average of the points which are available is used. If an even number is specified, the next higher odd number is used.

Add Points

The user may add to his display, but not to his data file which is being created as output. Points added will appear on the screen, will influence polynomial fits and smooths, but otherwise are ignored.

Delete Points

Points (both X and Y values) may be deleted from the display and from the data file in two ways. First, points can be deleted from among those points currently displayed only (i.e. repeat factor $\neq 1$). Secondly, points may be deleted from among all points in the temporary data file even though only every Nth point is displayed. This is done by the user establishing some criterion for the acceptance or rejection of points based on what is displayed, then applying this criterion to every point. This criterion can be specified through any one of the three buttons, "HORIZONTAL LINE", "CURVE FIT" or "BOX".

Immediately after selecting Delete Points, the user must reply to the message "CHOOSE ONE ITEM BELOW". The three items are:

1. Delete from this display only.

   If chosen, then subsequent deletions of points will be made only from the points displayed at this time.

2. Delete from current data base.

   If chosen, then subsequent deletions of points will be made from all points in the temporary data file, whether they are displayed or not.

3. Return to main menu.

   Neg tes the previous selection of "Delete Points" and returns to e user the opportunity to choose from the primary buttons. No o .etions will be performed.

Once item 1 or 2 is chosen, the user must select one of the four methods of deleting points listed here:

A. TRACKING CROSS

B. BOX

C. HORIZONTAL LINE

D. CURVE FIT

A. TRACKING CROSS

The user moves the tracking cross to a position near the point he wishes deleted. The point deleted will be the one which has the shortest straight line distance to the center of the tracking cross. He then selects ACCEPT. When he has deleted all the points he wishes to delete, the user selects DONE.

B. BOX

The user specifies lower left and upper right limits of a rectangle which is displayed on the screen. The user may accept or reject this rectangle. When accepted, all points within the box are deleted.

C. HORIZONTAL LINE

The user specifies a Y value and a horizontal line is displayed at that height. The user accepts or rejects it. When accepted, the user specifies whether points below or above are to be deleted.

D. CURVE FIT

There must be one and only one polynomial fit on the screen when CURVE FIT is selected. The user then specifies a percent above and below the curve to draw duplicate curves. When accept is selected, all points between the two new curves will be saved and all points outside will be deleted.

<u>Connect</u>

The display will be reconstructed in the form of line segments connecting the user's data points.

<u>Disconnect</u>

The display will be reconstructed in the form of isolated points, "." displayed at the coordinates specified by the user's data.

<u>Change X-Axis</u>

The user defines an interval or segment which is of special interest to him. He does this by positioning the tracking cross at the left and right limits he desires (the heights are unimportant). All points which have X values in this interval are displayed; all other points are not. This interval is scaled to span 15 inches.

<u>Change Y-Axis</u>

The user is given the choice of a logarithmic or linear Y axis. If a linear axis is chosen, minimum and maximum values for the axis must be entered next. If logarithmic, the lowest exponent is specified as is the number of cycles (decades).

5.6

Save Current Data

At any point in the processing the user may define the display on the screen as "original data" which can be redisplayed whenever desired. To define "original data" the user simply selects Save Current Data. Results of "Smooth" are not saved unless this button is selected.

Display Original Data

By selecting this button, the user clears the current display and replaces it with the data last declared as "original data". It is important to note that each time a new frame is displayed with the button "PROCEED TO NEXT FRAME," the display produced is defined as "original data".

6.0

VI. HARDWARE REQUIREMENTS

Computer (Manufacturer's Name): Control Data Corp.

Computer Requirements:

Central Processor (CP) Yes X No ___

Peripheral Processor (PP) Yes X No ___

Plotter Yes X No ___

Calcomp ___

CRT X

Other (specify) ___

Printer Yes X No ___

Punch Yes ___ No X

Graphics Yes X No ___

Disk Packs Yes X No ___

Common X

Private ___

VII. SOFTWARE REQUIREMENTS

Operating System Software:

SCOPE __X__

IBSYS ____

Other (specify) ____________________

Compilor:

FTN __X__

RUN ____

Other (specify) ____________________

Source Program Language:

FORTRAN IV __X__

COMPASS ____

Other (specify) ____________________

Supporting System Software:

Sort/Merge ____

Update ____

Utility ____

Editsym ____

Other (specify) ______IGS______

VIII. INPUT

A. Punched Card

Card No.	Variable Name	Card Col.	Format	Variable Description

Card	Columns	Contents	Format
1	1-2	Digigraphics console number on which user wishes display to be generated.	I
2	1-2	Number of 10 character words containing heading for CRT plots.	I
	3-5	Number of words in each logical record in the user's permanent file.	I
	6-7	Number of logical records in each physical record in the user's permanent file.	

(Continued on page 8.1)

B. Magnetic Tape NONE

Name ________; No. of Files _____; Density_____BPI; No. of Tracks_____;

Type (Bin. or BCD_______; Label: Yes ____ No ____; No. of Reels _____.

Number of Words in Record ________________.

Indicate record format and attach separate sheet as illustration.

C. Other

Graphics ____ Paper Tape ____ Keyboard ____ Disk Pack ____

Card	Columns	Contents	Format
	8-57	Heading for plots	A
3	1-30	User's name and problem # in free format.	A
4	1-9	Label for first word in logical record	A
	10	Blank if word above is in floating point format or "I" if integer.	A
	11-19	Label for 2nd word	A
	20	Blank or "I" for 2nd word	A

Continue until all words in logical record have received a label.

B. DATA FILE (PERMANENT FILE)

The user's data file may consist of any number of physical records terminated by an end of file. Within each physical record, the user may block several logical records. This procedure is recommended because it minimizes program I/Ø time. The only restriction to be honored is that the product of the number of words in each logical record and the number of logical records blocked into each physical record must not exceed 300.

The user's data file must reside as a permanent file currently on the system.

Each word in a logical record must be in either integer or floating point format.

The value -99999.0 is used internally to denote XY pairs not to be displayed. The user is advised to avoid use of this value except for the above purpose.

IX. OUTPUT

Describe the normal program printed output and the configuration of any magnetic tape, paper tape, and/or any punched cards generated.

Output

Printed Output

A listing of the user's data, which he has edited, is given after job termination. In this listing, any values deleted will appear as -99999.0 or -99999 depending on the format specified for that word. Points added to the display will not be added to the data file nor will they appear in the listing.

Permanent File

A permanent file is created in the same format as the input file. That is, the same number of words per logical record and the same number of logical records per physical record. The values in this new file are exactly those values listed under "Printed Output" above. This new file will only contain data records whose key word value lies within one of the user-specified intervals for the key word.

(Continued on page 9.1)

Page Estimate depends on size of user's file (1 line per record)

Size of Printout Paper 11 X 14

Number of Copies 1

Plotted Output

When requested, a CRT plot is made containing the following items:

a. X axis with label

b. Y axis with label

c. line plot of Y vs X

d. the heading specified by the user

e. the starting and ending values of the key word

f. the repeat factor

g. if the data has been smoothed, the number of points in the smooth.

X. MATHEMATICAL OR LOGICAL PROCEDURES

Describe logical steps taken by program to accomplish tasks outlined in the functional description section. Include mathematical symbols used, mathematical techniques, equations, special programming techniques, table structures, indexing and indirect addressing, initialization and reinitialization.

The mathematical and logical procedures of Autoedit are in 32 sections, each section describing one overlay.

The interactive nature of Autoedit makes it impossible to predict the sequence in which these overlays will be executed. Therefore, each one is treated independently of the others.

Overlay 0 (Program Test)

Program Test simply declares the storage necessary for the labelled common blocks which are to be kept in core throughout the execution of the other overlays. A total of 1043_{10} locations are named and reserved.

In addition to 1043_{10} locations for labelled common, 5 subroutines are also kept in core so that they may be accessed by any of the 31 other overlays. These subroutines are the following:

Subroutine ANNOTA(XINCH,YINCH,XOCD,NC,IDDAD,IDDT,IDDC,ROUTE)

where	XINCH	is the X coordinate in inches of the lower left corner of the message to be displayed.
	YINCH	is the Y coordinate in inches of the lower left corner of the message to be displayed.
	XBCD	is an array containing, in display code, the message to be displayed.
	NC	is the number of characters in the message.
	IDDAD	is the associative address of the display item.
	IDDT	is the type code word.
	IDDC	is the code word.
	ROUTE	is the IOWA of the item.

Subroutine GINE(XARY,YARY,NPTS,K5,XMIN,XDELTA,YMIN,YDELTA,IDDAD,

IDDT,IDDC,ROUTE)

where XARY is the array of X values.

YARY is the array of Y values.

NPTS is the number of points in XARY and YARY which are to be displayed.

K5 is a switch set to either 0 or 1.

XMIN X value of origin.

YMIN Y value of origin.

XDELTA DGU per inch along X axis.

YDELTA DGU per inch along Y axis.

IDDAD,IDDT,IDDC,ROUTE are as in ANNOTA.

This subroutine converts all values to DGU's by the formula:

IX = ((XARY(N)-XMIN)/XDELTA)*DGUPIN+XORDGU

IY = ((YARY(N)-YMIN)/YDELTA)*DGUPIN+YORDGU

where XORDGU and YORDGU are referenced in labelled common block /PARMSV/.

If K5 = 0, each X,Y point is displayed as a line segment from (X+3,Y) to (X-4,Y). This line segment is so short (7DGU) that it appears as a dot on the screen.

If K5 = 1, each (X,Y) pair is displayed as a line segment from (X(N-1), Y(N-1) to (X(N), Y(N)), where N = 2,..., NPTS. Care must be taken to restrict the value NPTS to 50 or less for each call to GINE. If NPTS .GT. 50, the IBUF array cannot contain all the required information, and a partially completed display will result.

Subroutine DISPLAY(X,Y,NPI)

where X is array of X values

Y is array of Y values

NPI is number of points to be displayed

This subroutine subdivides the X and Y arrays into 50 point segments for calls to GINE.

Subroutine KEYS(X,Y,ALPH,NALPH,NC,VBCD,VAL,IVAL,FMT,TYPE,K)

where X and Y are not used.

ALPH	is the array containing the message to be displayed above the dashed lines.
NALPH	is the number of characters in ALPH.
NC	is the number of characters to expect the user to input via the keyboard.
VBCD	is the array which will contain the alphanumeric information entered by the user via the keyboard.
VAL	is the word containing the floating point number which has been decoded from the keyboard.
IVAL	is the word containing the integer value entered via the keyboard.
FMT	is not used.
TYPE	is a switch set to either "R", "I", or "A" in left justified display code.
K	is the number of characters entered by the user if an alphanumeric entry is requested.

This subroutine displays a prompting message and NC+1 underlines on the screen. When "/" is entered, the alphanumeric information is retrieved and entered into array VBCD.

If TYPE = "A" (alphanumeric), the array VBCD is returned as is with K set equal to the number of characters entered -1 (to discount the end of message character, "/").

If TYPE ≠ "A" the number of characters entered is encoded into the format array FMTT, under the FORMAT (2H(E,I2,6H.0)bbb). Each character is then checked for validity and rejected if:

1. it is a letter or special character (other than E, +, -, or .)

2. + or - appears a total of more than once before an "E"

3. . or E appears more than once each

4. . appears after E

5. + or - appears more than once after an "E"

If any character is rejected, the entire entry is repeated on the screen along with an explanatory message instructing the user to re-enter the number.

If there are no rejected characters, the array VBCD is decoded into the word VAL. Thus, IVAL is set equal to VAL. This allows the user to enter values in integer, E, or F format.

Subroutine GETCHAR(NWORD,NCHAR,KCHAR,ARRAY)

where NWORD specifies the word number within ARRAY

NCHAR specifies the character number within ARRAY(N WORD) counting from left 1-10.

KCHAR is the desired character returned.

ARRAY is the array of input words.

This subroutine separates a single character from ARRAY(N WORD) by first creating a mask of all zeros but for six 1's positioned in the same places as the six bits defining the character desired. This mask and the word ARRAY(N WORD) are "AND ed" to produce a word of all zero bits except the six defining one character. These bits are shifted left, end around, NCHAR * 6 places so that they now are left justified in KCHAR.

Program Test, finally, calls subroutine AEXEC. For a description of this routine, see Control Data 6000 Series Computer Systems 274 Interactive Graphics System Reference Manual.

Overlay 1 (Program STRT)

Program STRT places the value 0 in all locations reserved for labelled common. The 923rd location in labelled common is loaded with an integer 1 to indicate connected line segments in any calls to GINE until

changed at user's option.

Three subroutines which are described below are called, and control is passed to Program STIT, (Overlay 30_8)

The three subroutines are:

1. Subroutine INIT

This subroutine reads a card defining NCON, the console number. Several constants are defined, namely MBYTE, ICODE,ISTYLE and IBEAM. These are stored in /GENAL/.

The console, NCON, is attached by the call CALL GICNJB(NCON) and masks for pick processing are next defined.

2. Subroutine ORIGIN(XORG,YORG)

where XORG is the X coordinate in inches of the origin.

YORG is the Y coordinate in inches of the origin.

This subroutine converts the XORG, YORG values to DGU's by multiplying by 200.0, the number of DGU's per inch. The results, XORDGU and YORDGU are stored in /PARMSV/.

3. Subroutine BUTTONS

This subroutine displays the primary buttons on the screen:

SEGMENT PLOT READ FIT EDIT STOP and RESET.

<u>Overlay 2 (Program RERN)</u>

This program is called into execution by the RESET button. All points are erased from the screen. All messages concerning the repeat factor and smooths are erased. Both X and Y axes are erased.

Control is then transferred to Overlay 32 (Program DATA)

<u>Overlay 3 (Program REED)</u>

This program is called into execution by the READ button.

Three secondary buttons are displayed:

1. PROCEED TO NEXT FRAME
2. CHANGE KEY WORD OR X,Y PAIRS
3. RETURN TO MAIN MENU

If 1 is picked, control is transferred to overlay 33, Program READ.

If 2 is picked, control is transferred to overlay 32, Program DATA.

If 3 is picked, control is transferred to the next primary button selected.

Overlay 4 (Program Plot)

This program is called into execution by the Plot button. Three secondary buttons are displayed:

1. PRODUCE PLOT
2. CHANGE HEADING
3. RETURN TO MAIN MENU

If 1 is picked, control is transferred to overlay 26, Program HCPY.

If 2 is picked, control is transferred to overlay 31, Program CPAR.

If 3 is picked, control is transferred to the next primary button picked.

Overlay 5 (Program EDIT)

This program is called into execution by the EDIT button.

Seven secondary buttons are displayed. Below is a table showing each button and the overlay and program name to which execution is passed when that button is picked.

Button	Overlay	Program
SMOOTH	20	SMTH
ADD POINTS	7	ADD
DELETE POINTS	10	DLTE
REPEAT FACTOR	16	RPET
CONNECT	15	CNCT
DISCONNECT	17	DISC
RETURN TO MAIN MENU	-	-

Overlay 6 (Program SEGS)

This program is called into execution by the SEGMENT button. Five secondary buttons are displayed. Refer to the table below:

Button	Overlay	Program
CHANGE X-AXIS	27	XAXX
CHANGE Y-AXIS	24	YAXX
DISPLAY ORIGINAL DATA	36	DSPL
SAVE CURRENT DATA	37	SAVE
RETURN TO MAIN MENU	-	-

Overlay 7 (Program ADD)

The coordinates of the tracking cross are fetched when the user picks "ACCEPT". These coordinates (in DGU's) are converted to inches by:

XX = (IH-XORDGU)/DGUPIN

and YY = (IV-YORDGU)/DGUPIN

where IH, IV are the coordinates of the tracking cross, and DGUPIN = 200.0 and XORDGU and YORDGU are from /PARMSV/.

From inches, the values XX and YY are converted to user's values by:

XX = XX*DX+XMIN

YY = YY*DY+YMIN

These values are stored in the X and Y arrays respectively. The

X array is scanned to find a point such that the new XX value lies between two consecutive X values. Then XX replaces the larger and it and all larger values are moved to one location higher in the X array. Thus, if

X(N).LE. XX .LE. X(N+1), then XS = X(N+1) and YS = Y(N+1) and IZS = IZ(N+1)

X(N+1) = XX and Y(N+1) = YY and IZ(N+1) = 0

XS1 = X(N+2) and YS1 = Y(N+2) and IZS1 = IZ(N+2)

X(N+2) = XS and Y(N+2) = YS and IZ(N+2) = IZS

XS = X(N+3) and YS = Y(N+3) and IZS = IZ(N+3)

X(N+3) = XS1 and Y(N+3) = YS1 and IZ(N+3) = IZS1

etc.

Where IZ(N) is a word containing the bead address and component word number in the form:

```
IZ(N) = BBBBBCC

        bead   component
                 word
        add.    number
```

<u>Overlay 10 (Program DLTE)</u>

This program is called into execution by the DELETE POINTS button. This program serves three main functions:

<u>1</u>. Allows the user to define whether deletions are to be made from current display only or from entire data base, whether displayed or not.

<u>2</u>. Allows user to choose the method of deleting: horizontal line, box, tracking cross, or curve fit.

<u>3</u>. Deletes by tracking cross (if selected).

<u>1</u>. If current data base is selected, the variable NALL is set = 1 as a

flag for the four delete routines. If not, NALL = 0.

2. Control is transferred to the program which deletes by the method chosen:

Method	Program to which control is passed
Tracking Cross	DLTE (statement 10)
Box	BOX (overlay 11)
Horizontal Line	HLIN (overlay 12)
Curve Fit	DFIT (overlay 13)

3. If Tracking Cross is chosen, the user positions the cross over the point to be deleted and then picks ACCEPT. When ACCEPT is picked, subroutine RMOVE finds the data point closest to the cross in a straight line.

$$\text{Distance} = \sqrt{(X_{cross} - X(I))^2 + (Y_{cross} - Y(I))^2}$$

for all I. The I yielding the smallest Distance is saved; X(I), Y(I) and IZ(I) are removed from the arrays and the remaining elements are moved as:

X(I) = X(I+1), Y(I)=Y(I+1), IZ(I)=IZ(I+1)

X(I+1)= X(I+2), Y(I+1)=Y(I+2), IZ(I+1)=IZ(I+2)

Also, -99999.0 replaces the Y value in the bead defined by IZ(I)

Overlay 11 (Program BOX)

The user specifies XH(1), YV(1) the lower left-hand coordinates of the rectangle, and XH(2), YV(2), the upper right-hand coordinates. In case the user reversed the upper right and lower left coordinates, XH(1)=smaller of XH(1), XH(2); XH(2)=larger of XH(1), XH(2); YV(1)=smaller of YV(1), YV(2) and YV(2)=larger of YV(1), YV(2). This precaution also accommodates the situation in which the left values are greater than

the right values.

The X array and Y array are searched to find an I such that

XH(1) .LE. X(I) .LE. XH(2)

and YV(1) .LE. Y(I) .LE. YV(2)

When one is found, X(I), Y(I) and IZ(I) are removed from their respective arrays and the value -99999.0 replaces the Y value in the bead defined by IZ(I).

If NALL = 0, the task is ended; if NALL = 1, the following steps are taken:

1. The entire data management file is searched, bead by bead, for a bead whose switch word contains an acceptable value.

2. When one is found, the X value is checked to see if XH(1) .LE. X .LE. XH(2). If X does not fulfill this criterion the bead is kept intact. If it does, then:

3. If YV(1) .LE. Y .LE. YV(2), the Y value is replaced by -99999.0. If Y is outside the limits the bead is unaltered.

Overlay 12 (Program HLIN)

The user defines a Y value by either entering it through the keyboard or by positioning the tracking cross at the desired height.

After converting the Y value from DGU to inches and the corresponding user's values, HLIN displays a horizontal line at this height. The user accepts or rejects this line. If rejected, it is erased and a new one may be defined.

If accepted, the user specifies whether points above the line or below the line are to be deleted.

The X array is scanned to find all I values such that X(I) lies within the segment currently on the screen. That is(IFPIS).LE.(I).LE.

(IFPIS+NPIS-1).

For all I in this range, Y(I) is checked to see if it is to be deleted. If points above the line are to be deleted, J=1; if below, J=2.

If J=1 and Y(I) is above the line or, if J=2 and Y(I) is below the line, then Y(I) is deleted from the Y array, as are X(I) and IZ(I). Also, -99999.0 replaces Y(I) in the proper location within its bead.

If NALL=0, HLIN is terminated.

If NALL=1, the data management file is searched as follows:

1. See BOX

2. When one is found, the X value is checked to see if X(IFPIS) .LE. X .LE. X(IFPIS+NPIS-1). If not, the bead is unchanged.

3. If so, the Y value is checked to see if J=1 and Y above line or J=2 and Y below line. If either is true, -99999.0 replaces the Y value. If not, the bead is unchanged.

Overlay 13 (Program DFTT)

DFTT assumes one and only curve fit is presently displayed on the screen. If more than one is being displayed, an error message is issued. Variables XL and XR are defined as the left and right limits in X of the current display.

The user enters a factor by which the value of the curve at Y1 is multiplied. Variables X1 and Y1 in /CURVE/ represent the first (X,Y) pair of the curve. The product of Y1 and the factor entered by the user (PCT) is added to Y1 to get YY1 and subtracted to get YY2. These values are used as new Y values for 2 curves which are duplicates of the original one. Duplicate curve, f_1, then, is simply the original curve (f(x) + (Y1*PCT) and curve f_2 is the original curve f(x) - (Y1*PCT). These 2 new curves are then displayed. The user may accept these curves or reject

them and redefine PCT.

When curves have been accepted, the X array is searched to find all I such that f_1(X(I)-XMINFIT) .LE. Y(I) .LE. f_2(X(I)-XMINFIT). Then for all other I, X(I), Y(I) and IZ(I) are removed from their respective arrays, and -99999.0 replaces Y(I) in the bead defined by IZ(I). The argument [X(I)-XMINFIT] is used because function F1(X) uses coefficients A(J), J=1, 10 from /DFTTT/ which are computed from a fit to $\{(a,b) \mid a=X(I)-XMIN, b=Y(I)\}$. See Overlay 21 for further details.

If NALL = 0, DFTT is terminated.

If NALL = 1, the following steps are followed:

1. See HLIN

2. See HLIN

3. If f_1(X(I)-XMINFIT) .LE. Y(I) .LE. f_2 (X(I)-XMINFIT) then the bead is unchanged. For all I for which this is not true, -99999.0 replaces Y(I) in the bead.

Function F1(X)

This function computes f(X) where f is a polynomial of degree M1-1 and the M1 coefficients, in ascending order, are A(1), A(2), ... A(M1). These coefficients are computed in Overlay 21, Program FIT and are transmitted by /DFTTT/.

If X=0, F1 is set to A(1) to avoid evaluating 0°.

Overlay 14 (Program ERRR)

This program erases two lines from the screen. These lines are error messages: "NO FITS ON SCREEN. ERROR."

"MORE THAN ONE CURVE DISPLAYED. ERROR."

They are erased when they are picked with the lightpen.

Overlay 15 (Program CNCT)

This program sets M, in /MVAL/, equal to 1 as a flag for GINE.

Overlay 16 (Program RPET)

This program allows the user to enter a new value for KRPT, the repeat factor. It is stored in the 81^{st}_{10} location of /ADDS/.

Overlay 17 (Program DISC)

This program sets M in /MVAL/ equal to 0 to signal GINE not to connect points.

Overlay 20 (Program SMTH)

The user enters KS through the keyboard. Then for each Y(I), the KS values:

$Y(I-\frac{KS}{2})$, $Y(I-\frac{KS}{2}+1),\ldots, Y(I),\ldots, Y(I+\frac{KS}{2})$ are averaged and this average, AVE(N-IFPIS+1), replaces Y(I). However, the original value of Y(I) is needed for the next $\frac{KS}{2}$ averages. Therefore, the new value, AVE(N-IFPIS+1) is saved until the old Y(I) is not needed for averages I+1, I+2, ..., $I+\frac{KS}{2}$. When these averages have been computed, Y(M) = AVE(N) where M = IFPIS, ..., IFPIS+NPIS-1. and $N = M+\frac{KS}{2}+1$.

Overlay 21 (Program FIT)

This program performs 8 separate functions:

1. User defines the interval to be fit.
2. User defines the degree of the polynomial.
3. The polynomial is computed.
4. The user defines the extent of the curve to be shown.
5. The polynomial is evaluated at 40 points in the interval defined in 4.
6. These 40 X and 40 Y values are stored in a bead with address IBD.

7. The address of the bead, IBD, is stored in the 81st word of the previous bead.
8. The user can redefine 1, 2, 4 at his option.

1. The user moves the tracking cross to define a left and right (Min & Max) limit for the interval. Only $\{(X,Y) \mid X_{min}$ .LE. X .LE. $X_{max}\}$ will be fit.
2. User enters degree of the polynomial, 1-9 via the alphanumeric keyboard.
3. Subroutine POLYNO is first called with the foll.. ;g arguments in this order:

    a) 0

    b) X1(J1) is the first element of X array in the interval to be fit.

    c) Y1(J1) is the first element of Y array in the interval to be fit.

    d) J3 is the number of X and Y values to be fit.

    e) I is the degree of the fit.

    f) IP1 = I + 1

    g) AA is the array of coefficients to be displayed on the screen.

    h) SSQS, POLYN, ALPHA, BETA, B, OMEGA, GAMMA, C, P are not used in FIT but are necessary for POLYNO.

    A second call is made to POLYNO with the following argument changes.

    b) X1(J) is now the Jth element of the X1 array after XMIN has been subtracted from each element. This is done to try to avoid large X values which do not work well in later evaluation of the polynomial.

    g) A is the array of coefficients used for later evaluation of selected X values, where each X is some X1(I) - XMIN.

Since XMIN may be subsequently changed, the current value of XMIN is saved in location 1 of /XMFT/.

4. Once the coefficients have been computed, the polynomial may be plotted over any interval of X values. The user, then, is given the opportunity to select an interval over which 40 X values are chosen equally spaced such that X(1) = the minimum X in the chosen interval and X(40) = the maximum.

5. For each of the 40 X_i values chosen, Y_i is computed as: $Y_i = \sum_{j=0}^{I} a_j x_i^j$ where I is degree of polynomial, a_j are the coefficients from 3)g, and X_i = X(I) - XMIN

6. The value in location 1 of /FITBD/, IBFIT; is the bead address for the bead containing the data for the first curve which was generated. The format of this bead is:

Word	Contents
1-40	X(1) - X(40)
41-80	Y(1) - Y(40)
81	address of next bead (pointer)
82	associative address of curve displayed.

Common block /LSTFIT/ is used to store the bead address of the last bead in the string. Thus, when a new bead (IBD) is added, word 81 in this last previous bead is set equal to the new bead's address: CALL DMSET(ICMP + 81, LASTFIT, IBD). The value -99999 is used to indicate the end of the bead string.

8. The user is now given 5 options:

a) redefine the interval to be fit.

b) redefine the degree of the polynomial.

c) redefine the extent of the curve to be displayed.

d) compute the new display.

e) return to main menu.

The user may select a, b, c, d, or e. If e is selected, FIT is terminated. If a, b, or c is selected, d must be selected next to compute the new polynomial.

Subroutine POLYNO] See AFCRL documentation library for
]
Subroutine EVALUA] a description of these subroutines.

Overlay 22 (Program DFIT)

This program performs 2 functions when any curve is picked by the user:

1. erase that curve from the screen.
2. store 0 in word 82 of its bead to indicate that it is off.

Overlay 23 (Program DDDD)

This program erases the display of coefficients generated by FIT.

Overlay 24 (Program YAXX)

This program allows the user to redefine the type and characteristics of his Y-axis.

The user first chooses the type of Y-axis he desires: logarithmic or linear.

Next, if linear is chosen, the user defines the minimum and maximum values of the axis. Once these YMIN and YMAX values are defined, DY, the change in Y per inch is computed.

DY = (YMAX - YMIN) / 8.0 inches

If logarithmic is chosen, the user defines the new minimum exponent of 10 and the number of cycles (decades) to be contained in the axis.

SUBROUTINE GXIS(XINCH,YINCH,XLENIN,THETA,XMIN,DELTA,ISIGN,IDDAD,IDDT.IDDC)

where XINCH is the X coordinate in inches of the starting point for the axis.

YINCH is the Y coordinate in inches of the starting point for the axis.

XLENIN is the length of the axis in inches.

THETA = 0°, 90°, 180° or 270° and is the angular orientation of the axis clockwise from the horizontal.

XMIN is the coordinate value of the first point of the axis.

DELTA is the units per inch along the axis.

ISIGN = -1 if annotation is to be on clockwise side of axis.
= +1 if counterclockwise side.

IDDAD associative address of display item.

IDDT ID type word.

IDDC ID code word.

This subroutine generates an axis of length XLENIN. The axis contains tic marks every inch. THETA, in degrees, is converted to THR, in radians by:

THR = .01745329 * THETA

for each inch of axis, the number of DGU's to elevate and move right are calculated by IHDEL = cos (θ) * 200.0 and IVDEL = sin (θ) * 200.0.

A seven character number (F7.1) is displayed beneath each tic mark. In order to conserve display items, the axis line, all tic marks, and the XLENIN + 1 values are one display item, while the label is a second item.

SUBROUTINE GOGAX(X,Y,BCD,N,NUMCYC,CYCLEN,BEGEXP, THETA,IDA,IDT,IDC)

Except for the items listed here, Subroutine GOGAX is identical to Subroutine LOGAX which is in the AFCRL Documentation Library. For a copy of this documentation, see AFCRL Documentation Library.

Exceptions:

1. all display is generated on graphics screen.
2. height of all characters is .12 inches
3. THETA must be 90.0

SUBROUTINE GYMBOL(X,Y,H,A,T,N)

X = x coordinate in inches of lower left corner of first character.

Y = y coordinate in inches of lower left corner of first character.

H = not used

A = alphanumeric information to be displayed.

T = not used

N = number of characters in A.

This subroutine displays N Alphanumeri ' . ters on the console screen. X and Y are relative to the currently de . ed origin.

SubroutineGUMBER(X,Y,H,C,T,N)

X,Y = see GYMBOL

H = is unused

C = integer to be displayed

T = unused

N = number of characters to be displayed

This subroutine converts a floating point number, C, to integer, NC, and then to display code, A. The leading blanks are removed and the result is displayed by Subroutine GYMBOL.

SUBROUTINE GLOT (X,Y,N)

X = x start in incl. s of line

Y = ystart in inches of line

N = unused

A line segment 8" in length is drawn from (x,y) to (x,y+8).

Overlay 25 (Program STPS)

This program performs three main functions:

1. Fetches the values stored in the data management file and stores them in an array in core.
2. Fetches the format stored in the data management file and stores it in core.
3. Prints and copies to a permanent file all values fetched.

1. Each bead is made up of NWORDS+1 words. As each of the first NWORDS words are fetched, they are stored in array XBUFF under index IWD which is calculated by IWD = NWORDS* (J-1) +K where J is the number of beads processed so far, including the current one, and K is the word number being fetched. The (NWORD+1)th word contains the address of the next bead. A value of -99999 signals the end of the bead string. After a bead has been processed, each word which has been converted from integer format to floating point format (INTG(I), I=1, NINTS) is converted back to integer format.
2. NWORDS2 = NWORDS+2 = the number of words in bead IFBEAD used to store the printing format. This format is fetched and stored in FMAT(1) through FMAT(NWORDS2).
3. Now the array XBUFF, when it contains exactly NWORDS * NRECPR words, is printed and written to an output file (Tape 2)

for optional retention by the user. If the end of the bead string is reached before NWORDS * NRECPR words have been fetched, the remaining words are filled with the value -99999.0 or -99999 depending on the format.

Overlay 26 (Program HCPY)

This program generates plot instructions to create one CRT plot frame. The structure of the plot is described under Output, p. 9.0.

The variable L is used in calls to the plot subroutine LINE. If L=0, a line plot with no symbols is made. If L=-1, a point plot with symbols at every point is made using the symbol X of size .02". Variable LINER is set to 0 if current display is disconnected or it is set to 1 if connected. Thus, L=LINER-1. Variable LIN=0 if a logarithmic axis is in use; LIN=1 if a linear axis is used. Variables IFPIS and NPIS are the first element of the array currently displayed and the number of elements of the array currently displayed respectively.

Next, the bead string used to store the values of any polynomial fit curves is searched to see if any curves are currently being displayed (word 82≠0). If so, the 40 x-values and 40 y-values are loaded into arrays BB and VV respectively and these arrays are used in calls to LINE. The index of the first point of the curve in the current display is retrieved from array IST in /PLTFIT/.

SUBROUTINE LOGAX

See AFCRL Documentation Library for a description of this subroutine.

Overlay 27 (Program XAXX)

The user moves the tracking cross to redefine left and right limits

of the display. The IH and IV arguments of GITCOF are converted from DGU's to user's values so that the portion of the X array and the corresponding portion of the Y array which fall in the range just defined can be identified. The variable IFPIS is set equal to the smallest N such that X(N) lies in the chosen range. Variable NPIS is set equal to the total number of N within the selected range.

The polynomial fit bead string is also examined in a similar way with 1ST(KK) equal to the smallest N such that XFIT(N) lies between the left and right limits of the display. Variable INPTS(KK) is set equal to the total number of N from the polynomial curve within the selected range.

Overlay 30 (Program STTT)

This program reads the data cards 2-N as described on p. 8.0 section A. Variable NREC is set euqal to NRECPR so that the first call to Subroutine RDRECC will read the first record from the user's input data file (see Overlay 33-Subroutine RDRECC).

The variables which are defined as integer ("I" in character 10 of their label) are noted in array INTG and the total number of them is stored in NINTS.

The print format is now generated:

FMTT Word #	Contents
1	1H(
2 - NWORDS+1	10H,2XI10bbbb if integer or
	10H,2XF10.3bb if floating point
NWORDS+2	1H)

Then the character "/" is encoded at the end of FMTT(N) for N=11, 21, 31,... to print 10 words on each line. The format is then stored in data management in a bead of NWORDS+2 with address IFBEAD stored in /FFFFFF/.

Overlay 31 (Program CFAR)

This program allows the user to change the information contained in the alphanumeric heading printed on each frame of CRT plots created.

Overlay 32 (Program DATA)

Four buttons are displayed: KEY DONE X-Y VALUES SWITCH

The user selects any one and if he selects:

KEY, he can enter the word number to be treated as the key word, the starting value for this word, and a range for the values of this word. In general, a single display is made up of all data records whose key word has a value: START .LE. KEY .LE. START + RANGE.

DONE, a check is made of the variable IONE. IONE is initially set = 0, and is incremented by 1 the first time KEY is picked and by 2 the first time X-Y VALUES is selected. The user must select both of these buttons initially for Autoedit to begin processing. If he attempts to select DONE before IONE = 3, control is passed to the button which he has not yet selected. If IONE = 3, then DONE terminates program DATA and calls program RPLT.

X-Y VALUES, The user may enter the number of (X,Y) coordinate pairs to be extracted from each data record. He then defines those words in the data record which are to supply the X values and

those which are to supply the Y values. Finally, he defines the type of Y axis to be displayed. If he is working with common logarithms as Y values, the user may wish to use the logarithmic Y axis. If not, he must use the linear.

SWITCH, the user defines one word in the logical record as a switch word, and the values of this word which are to be accepted. For example, if he defines the switch word as word number 4, and 1, 3, and 5 the only acceptable values for word 4, then all logical records will be ignored for values of word 4 other than 1, 3, or 5.

SUBROUTINE CHARSP(A,N,K,LL)

where A is the array containing integers separated by commas in display code format.

N is the number of characters in the array A.

K is the output array containing the integers in integer format.

LL is the number of integers returned.

Subroutine CHARSP is used to decode an alphanumeric character string in the form I, I, I, I/

where I is an integer in display code comprised of any number of digits.

and , is the character comma.

All characters are examined. If "0".LE. C .LE. "9", then it is stored in array I in integer (if N is an integer in display code, then $N-27_{10}$ is that same integer (single character) in binary integer format). Once a "," is encountered, the L digits are combined into one integer by multiplying the Mth digit by 10^{M-1} and adding the L results.

Overlay 33 (Program READ)

This program performs the following functions:

1. erases any messages whose addresses are stored in variables IEOF(1) - IEOF(5). These messages are displayed when an end of file is encountered while reading the input file. See Subroutine EOFMESS.

2. A message detailing the key word, the starting value and end value is displayed. The end value is simply XSTART + RANGE.

3. The data from all beads currently in the data management bead string whose first bead address is stored in IBEAD1 are retrieved and moved to array XBUFF for printing (See Overlay 25, Program STPS).

4. These beads are released to the data management file TAPE9 for later reassignment to subsequent strings: CALL DMRLBD(IBEAD).

5. The user's permanent file is next read. All integer words in the logical record are converted to and stored as floating point. The key word, BUFF(KEY), is checked against XSTART. If it is less than XSTART, the next record is read and the current one is not saved.

This procedure is continued until either an end of file is encountered, or a value of the key word is greater than or equal to XSTART. If this value is also greater than XEND an error condition exists, and a message to this effect is displayed. If XSTART .LE. KEY .LE. XEND, then that record is stored into data management as follows:

a) a new bead is requested with NWORDS+1 words and address IBNEW.

b) each word in the logical record, BUFF(1) - BUFF(NWORDS) is stored into words 1 - NWORDS of the bead just requested.

c) the address of the bead just requested, IBNEW, is stored in word NWORDS+1 of the last bead, IBEAD.

d) IBEAD = IBNEW and the next logical record is read.

Words within a bead are loaded by referencing a bead address and a component code. The component code is 0100000000000B+word number.

If READ is called into execution when the previous physical record read was an end of file indicator (IEOF(1) ≠ 0), then TAPE2 is rewound and NREC=NRECPR to signal RDREC to read the next (first) physical record.

If an end of file is encountered, the TAPE1 file is rewound and Subroutine EOFMESS is called.

SUBROUTINE EOFMESS

This subroutine is called whenever an end of file is encountered on the user's input permanent file. The message: "AN END OF FILE HAS BEEN SENSED ON YOUR INPUT FILE. YOUR INPUT FILE HAS BEEN REWOUND. IF YOU READ AGAIN, YOUR CURRENT OUTPUT FILE WILL BE LOST AND A NEW OUTPUT FILE WILL BE STARTED. ACKNOWLEDGE," is displayed.

The addresses of each line are stored in IEOF(1) - IEOF(5) in /EEE/.

SUBROUTINE RDREC(BUFF,BUFFER,NWORDS,NRECPR)

where BUFF is the logical record returned.

BUFFER is an array which contains one physical record, dimensioned (NWORDS,NRECPR).

NWORDS is the number of words in one logical record.

NRECPR is the number of logical records in one physical record.

Variable NREC in /RDRECC/ is a counter, indicating which logical record within the current physical record is being extracted. If NREC= NRECPR initially, then the last logical record has been extracted and a new physical record must be read.

Overlay 34 (Program DEOF)

This program is executed whenever any part of the end of file message is picked. It erases the message and stores a valid address in IEOF(1) as a signal that an end of file has been encountered.

Overlay 35 (Program E123)

This program erases two lines of error messages when either line is picked. The errors are encountered in Overlay DSPL.

Overlay 36 (Program DSPL)

For each KRPTth bead in the string starting at IBEAD1 in which the switch word contains an acceptable value, the words containing the X values and the words containing the Y values are retrieved. KRPT is the repeat factor. If KRPT = 1, every bead is used. If it is = 2, every other bead is used. If it is = 3, every 3rd bead is used, etc. The words containing the X values are located with component codes 010000000000B+NXWDS(1) to 010000000000B+NXWDS(NXY) where NXY is the number of X,Y pairs per record (bead). The same is done to locate the Y values. The X values are stored into array X in blank common and the Y values are stored into array Y, also in blank common. If X(N) or Y(N) is equal to -99999.0, that value is ignored and the corresponding X(N) or Y(N) value is ignored also. The array IZ contains an entry for each one in the X and Y arrays. Each IZ(N) equals IBEAD * 100 + J where IBEAD is the address of the bead from which the X(N) and Y(N) values were taken, and J is the pair number in that bead.

If 1000 X values are stored, the arrays are full and a message, "DATA ARRAYS CANNOT HOLD ENTIRE DATA BASE, INCREASE REPEAT FACTOR OR WORK WITH FIRST 1000 POINTS ONLY," is displayed.

Once all X, Y, IZ values have been loaded, KPOINTS is loaded with the number of X, Y, IZ values, and Subroutine SCALE is called to scale arrays X and Y, thus defining XMIN, DX, YMIN, and DY. These values are saved in /YSAVE/ as XMINS, DXS, YMINS, DYS for later reference.

All KPOINT points are then displayed with axes and labels. All fits are redisplayed (if they haven't been erased) based on the new XMIN, YMIN, DX and DY.

SUBROUTINE SCALE(ARRAY,NPTS,AXLEN,PTMIN,DELTA)

where ARRAY is the array to be scaled.

NPTS is the number of points in ARRAY.

AXLEN is the length of the axis over which the array is to be scaled.

PTMIN is the computed start of the axis.

DELTA is the computed units per inch along the axis.

Subroutine SCALE selects a scale for ARRAY which is easy to interpret. DELTA = 2, 4, 5, 8, or 1 times 10^N.

Overlay 37 (Program SAVE)

The information contained in X(N) and Y(N), N=1, KXY, is stored into data management in bead IZ(N)/100, at words 10000000000B+NXWDS(J) and 10000000000B+NYWDS(J) where J = MOD(IZ(N), 100), thus replacing the data previously contained in these beads.

XI. ERROR ROUTINES AND INDICATIONS

Error Condition Checks	Internal and External Indications	Recovery Procedure or Action Required

1. "GIDISP BUFFER OVERFLOW" message appears when screen cannot accommodate the entire display. User may continue by selecting RESET button.
2. All values entered via the alphanumeric keyboard are checked for validity when numbers are expected in a specific format. If invalid format or characters are entered, the invalid number is displayed and a message is issued that the user should re-enter the number correctly.

Cover all error condition checks, indications and recovery procedures set up in your program. Anything leading to a possible error, such as invalid data, sequence errors, incorrect formats, etc., should be listed. The document should define what internal and external indicators are set and what messages are printed out, and what action is required for each error message.

XII. PROGRAM RESTRICTIONS AND TIMING

List any special program restrictions that apply to this program only. If program restrictions are given elsewhere in the text, they should be repeated here.

Such items as maximum and minimum allowable size of input and output values, special buffer areas, etc., or anything that is unique to this program only should be listed here.

1. Maximum of 200 points may be contained in any interval to be fit by least squares curve.
2. Maximum of ~1000 points may be displayed on screen at any one time.
3. X and Y axis values are limited by +99999.9 to -9999.9. Any value outside of these limits will be trucated to 7 digits and digit one will be the character "*".

Timing

List the running time for the program in terms of number of records processed, number of cards processed, lines of output, or some other meaningful, measurable quantity.

13.0

XIII. INSTRUCTIONS FOR JOB SETUP

List System Control Cards

CARD INPUT (Control Cards)

Card	Contents
1	Standard AFCRL job card with CM47000, T50.
2*	ATTACH (CRT, CRTPLOTS, MR=1)
3***	FTN (LR,OPT=2)
4	COPYBR (CRT, LGO, 21)
5	FTN (LR, OPT=2)
6	REWIND (CRT)
7	COPYBR (CRT, LGO, 21)
8	FTN (LR, OPT=2)
9	SETCORE.
10	LOADER (PPLOADR)
11	LOAD (LGO)
12	SC1.

(Continued 13.1)

*Magnetic Tapes

Name	SCOPE	Stranger or Long	Logical Unit	Description

Maximum Core Storage Needed for:

Compilation 45K octal

Execution 45K octal

Standard Test Case Time Allocation 50 seconds

Sense Switch Settings -

*A sample copy of the data tape must be submitted with the documentation for checking purposes.

CARD INPUT (Control Cards)

Card	Contents
13	AEFILE.
14	RFL, 47000.
15**	SCI.
16****	7/8/9 multipunched
17	JT;
18	SCI
19	7/8/9 multipunched
20	JT1
21	7/8/9 multipunched

* If a card plot file is to be generated, the following card must be inserted: REQUEST, TAPE39, *PF.

** Also, the following card must be inserted:

CATALOG, TAPE39, XXXXX, ID = NNNNN.

where XXXXX is the user-defined permanent file name and NNNNN is the user's name.

*** If the duplicate file generated by AUTOEDIT is to be saved, the following card must be inserted: REQUEST, TAPE2, *PF.

**** Also, the following card must be inserted:

CATALOG, TAPE2, XXXXX, ID - NNNNN.

where XXXXX and NNNNN are defined above.

14.0

XIV. VERIFICATION OF OPERATION

Rerun program and check results with sample output submitted.	Yes ____ No _X_
Rerun program and compare tape(s) generated with original.	Yes ____ No _X_
Other (specify)	

Because of the almost limitless number of possible inputs, graphical displays and outputs, the user is advised to attempt to recreate a known display with his data base.

Variables S ·ed In Common

Common Block Name	Location	Contents
BBBB	1-300	the contents of one physical record for output purposes.
FIRST	1	the variable IONE as described in DATA.
JJJ	1	the number of logical records contained in /BBBB/plus 1.
EEE	1-5	the five addresses of the lines displayed when an end of file is sensed.
IAG	1-6	six addresses of the buttons displayed by FIT which allow the user to change INTERVAL, EXTENT, DEGREE, or to compute or return.
CRTPLT	1-3	3 ten character words used as first argument in calls to CRTPLT.
E1234	1-2	the two addresses of the error messages informing the user that the data arrays are full (1000 ptc.). Generated in DSPL.
BBB	1-300	the contents of one physical record as read from the user's file.
BLOK3	1	the address of the display containing the value of the key word when it is found to be larger than the end value before finding the starting value. Program READ.
ERRORS	1-2	the addresses of two error messages which are issued when the number of fits on the screen $\neq 1$
FFFFFF	1	bead address of first bead in string which contains format used in printing data
RDRECC	1	the logical record number within a physical record

Common Block Name	Location	Contents
HD	1	the number of characters in the heading produced on CRT frames.
EXPON	3	addresses of display containing coefficients of polynomial fit.
K12345	1	unused
INTEG	1-100	indexes of all integer words in a logical record.
	101	number of integer words in a logical record.
CURVE	1	X(1) for last polynomial fit.
	2	Y(1) for last polynomial fit.
DFTTT	1-10	coefficients of last polynomial fit.
	11	degree of last fit plus 1
YSAVE	1	XMIN for original display
	2	YMIN for original display
	3	DX for original display
	4	DY for original display
ALL	1	= 1 if deleting from data base, 0 otherwise
LSTFIT	1	address of last bead in polynomial fit bead string
LOGLIN	1-3	unused
XHEAD	=1-10	characters 1-10 of heading for X-axis
BLOCKF	1	number of logical records per physical record
YHEAD	1-10	characters 1-10 of heading for Y-axis
KEYHD	1-5	alphanumeric array containing information about key word. This information includes the label

Common Block Name	Location	Contents
KEYHD (Cont.)		for the key word, the starting and ending values.
BLOK1	1	address of first bead in data string.
BLOK2	1	address of display "KEY WORD GREATER THAN END VALUE BEFORE FINDING STARTING VALUE" issued by READ.
PLTFIT	1-10	starting index for arrays of X,Y values of polynomial fits.
	11-20	number of points in current interval for polynomial fits
	21	number of fits on screen
FITBD	1	address of 1st bead in string containing (X,Y) pairs from polynomial fits.
LOG	1	= 1 if linear axis; = 0 if log axis
CRTPEN	1	unused
PARAMS	1	number of words in CRT frame headings
	2	number of words in a logical record
	3-7	CRT heading (alphanumeric)
	8-57	labels for words in logical record
	58	word number of KEY word
	59	starting value of KEY word
	60	range of KEY word
	61-85	words which are to be used as X values

Common Block Name	Location	Contents
PARAMS (Cont.)	86-110	words which are to be used as Y values
	111	number of words used as X values
ZALP	1	address of display consisting of information in /KEYHD/
MAXY	1	maximum value of Y axis
BLANK, //	1-1000	X array
	1001-2000	Y array
	2001-3000	IZ array
	3001	index of first (X,Y) pair in current segment
	3002	number of points in current segments
	3003	number of points in X, Y, IZ arrays
YAXIS	1	number of cycles in logarithmic Y axis
ADR	1-2	addresses of blinking dots defining left and right limits of the interval which is to be fit.
	3	address of message, "TOO MANY POINTS IN INTERVAL. CHOOSE ONE ITEM BELOW."
RPTFCT	1	address of display detailing value of the repeat factor
PROM	1	address of display detailing value of KS, the number of points in each of the smooth averages
MVAL	1	= 1 means connect points in display = 0 means display isolated points
FITS	1-10	addresses of displays, each consisting of a polynomial fit

Common Block Name	Location	Contents
FITS (Cont.)	11	number of fits
PROMPT	1	unused
ADDS	1-2	addresses of X axis display
	3-5	unused
	6-40	addresses of data plot display
	41-80	addresses of Y axis display
	81	repeat factor
PLOTS	1	XMIN for current segment
	2	YMIN for current segment
	3	DX for current segment
	4	DY for current segment
GENAL	1	console number
	2	maximum number of bytes to pack in one IBUF buffer
	3	ICODE for calls to GURSET
	4	ISTYLE for calls to GUSEGI, GUSEGA, GUSEGS, GUSEG
	5	IBEAM for calls to GUSEGI, GUSEGA, GUSEGS, GUSEG
PARMSV	1	X origin in DGU's
	2	Y origin in DGU's
	3	# of DGU's per inch (200.0)
SMOOTH	1	number of points in each average computed by SMTH
XAXIS	1-2	unused
SWITCH	1-10	acceptable values of switch word

Common Block Name	Location	Contents
SWITCH (Cont.)	11	switch word
	12	number of values of switch word
XMFT	1	XMIN when last fit was made

DEPARTMENT OF THE AIR FORCE
AIR FORCE CAMBRIDGE RESEARCH LABORATORIES (AFSC)
LAURENCE G. HANSCOM FIELD, BEDFORD, MASSACHUSETTS 01730

REPLY TO ATTN OF: SUYA 8 March 1972

SUBJECT: Procedures for Submitting Problem Efforts to the Analysis and Simulation Branch Project/Problem Library

TO: All Analysis and Simulation Branch Government and Contractor Personnel

1. Once a problem submission is completed by an individual, it should be thoroughly reviewed by his (or her) supervisor.

2. The problem submission should then be (as appropriate):

a. Contractors - Submitted to the Contract Monitor, as completed, in accordance with contractual requirements.

b. Government Personnel - Submitted to Mr. A. Almon.

3. The Contract Monitor will direct the problem submission to the Analysis and Simulation Branch Library. Mr. Almon will do likewise.

4. Submission Procedures are as follows:

a. Problem submissions should be delivered to the blue storage bins in the main SUYA office.

b. Only one package per bin is permitted. In the event that all bins are full--please notify Mr. A. Almon, X-4161, he will make available additional space.

c. The problem submission will be validated in accordance with standard SUYA validation procedures. (See Attachment #1)

d. Once properly validated, the Contract Monitor will receive a notice of same. The submission will then be added to the SUYA data base for storage and subsequent retrieval. (See Attachment #2)

e. Should the submission prove invalid, it will be returned to the Contract Monitor with sufficient explanation for additions, modifications or corrections. The problem package (problem submission) should be corrected and resubmitted within ten working days. If this period of time is not sufficient, the Contract Monitor should, with reasons, so inform Mr. Almon. (See Attachment #2)

Eunice C. Cronin
EUNICE C. CRONIN, Chief
Analysis and Simulation Branch

2 Atchs

RESEARCH - The Key to Aerospace Superiority

Exhibit 4

Analysis and Simulation Branch (SUYA)
Project/Problem Library Documentation Requirements

1. The following are the required items to be included with each problem submission to the Analysis and Simulation Branch Project/Problem Library:

a. A typewritten (original) standard documentation form--duplicating machine copies are not acceptable.

b.(1) A copy of all source decks for a. above, including sample punched card input data. (Binary decks are not acceptable.)

b.(2) A copy of magnetic tape(s), paper tape, etc. required as Input to program(s) should be included with submission.

c.(1) A source listing including compilation, sample printed and/or card output and dayfile.

c.(2) A copy of magnetic tap s), paper tape, etc. required as Output from program(s) should be included with an appropriate tape dump of the first and last ten (10) records.

2. Each problem submission will be validated using the above. It is requested that the test case be chosen judiciously to: (1) validate the logical procedures set forth in the program as documented; and (2) utilize a minimum of computer time for checking purposes.

3. Should you have any further questions regarding the above, please contact Mr. Austin Almon, X4161.

Eunice C. Cronin
EUNICE C. CRONIN, Chief
Analysis and Simulation Branch
AFCRL Computation Center

Attachment #1

Exhibit 4 (Cont)

Date:

Analysis and Simulation Branch (SUYA)
Project/Problem Library Acceptance Report

Documentation Name: ______________________

Account & Problem No.: ______________________

Project, Task, Work Unit No.: ______________________

Initiator, Laboratory & Branch: ______________________

Company, Author, Contract No.: ______________________

1. As of the above date the noted problem submission has/has not(*) been accepted into the Analysis and Simulation Branch Project/Problem Library:

*The following requirements are to be fulfilled:

2. The corrected problem submission should be returned to Mr. Austin Almon within ten days of the above date.

EUNICE C. CRONIN, Chief
Analysis and Simulation Branch
AFCRL Computation Center

Attachment #2

Exhibit 4 (Cont)

Analysis and Simulation Branch (SUYA)
Project/Problem Library Intercom Submissions

1. All submissions to subject library which have been running under Intercom must be submitted in two modes:

a. Intercom Mode
b. Batch Processing Mode

2. All source decks used to catalog permanent files for use in the Intercom Mode should be submitted with the documentation package. Proper instructions to recatalog the permanent files must also accompany the submission.

Eunice C. Cronin
EUNICE C. CRONIN, Chief
Analysis and Simulation Branch
AFCRL Computation Center

Attachment #3

Exhibit 4 (Cont)

LEGEND

SYMBOL	COMPANY
ACSI	Analysis & Computer Systems, Inc.
ARCON	Arcon Corporation
BC	Boston College
DABCO	Dabcovich & Company, Inc.
DPSI	Digital Programming Services, Inc.
EAI	Electronic Associates Incorporated
GC	General Computering Services, Inc.
GOV	Government
HARV	Harvard University
LOG	Logicon, Inc.
LTI	Lowell Technological Institute
MARTIN	Martin-Marietta Corp.
PH	Phillip Hankins & Company
RE CAL	Research Calculations
RDP	RDP, Inc.
TMG	The Management Group
WOLF	Wolf Research & Development Corp.
WPI	Worcester Polytechnic Institute

Exhibit 5A

PREPARED BY/FOR THE ANALYSIS AND SIMULATION BRANCH (SLVA), AIR FORCE CAMBRIDGE RESEARCH LABORATORIES, TEL. 861-4161,

PAGE 25

PROGRAM LIBRARY INFORMATION LIST
STATUS - ALL PROBLEMS BELOW ARE COMPLETED
LISTED BY PROBLEM NUMBER

PROG. NO.	PROGRAMMER	COMPANY	INITIATOR	LAB	PROJ. NO.	TITLE
• 1600	VAN JORGE, H.	ACSI	HIGGINS, J.	LKO	5638	ANALYSIS OF PROTON DATA
• 1601	VALTINE, J.	GO	TSIPOURAS, P.	SLVA	0901	ORTHOGONALIZATION OF A SET OF N LINEARLY INDEPENDENT VECTORS
• 1602	RUSSELL, J.	RC	KUENZLER, H.	LKH	7630	PIEZOELECTRIC PROBE TRANSDUCER
• 1603	ARCENAULT, P.	ACSI	AARONS, J.	LIP	4643	SACRAMENTO PEAK RADIO OBSERVATORY EDIT SYSTEM
• 1604	GROSSBARD, N.	EC	SILVERMAN, S.	LKA	7661	DIGITAL FILTERING OF ROCKET DATA
• 1605	MACKINNON, J.	ACSI	VANCOUR, R.	PHG	7601	PROTON AND ELECTRON TELEMETRY DATA REDUCTION
• 1606	PUETAUER, J.	GOV	SMART, D.	PHE	4610	VERTICAL CUTOFF RIGIDITY DERIVATIONS
• 1607	WRIGHT, N.	IBM	REDI, [illegible]	LIP	8608	OGO-F TELEMETERED DATA REDUCTION
• 1608	PERPAKIS, I.	DAPCC	JASPERSE, J.	LCP	5621	ELECTRON-HYDROGEN SCATTERING
• 1609	GROSSMAN, P.	DAPCO	ECKHARDT, [illegible]	LWG	8654	AFCRL LUNAR LASER CONTROL TAPE
• 1610	ARMSTRONG, D.	ACSI	RUSH, C.	LII	5631	ELECTRON DENSITY DISTRIBUTION IN THE IONOSPHERE
• 1611	CONWAY, F.	ACSI	VIDERBERG, J.	LII	5631	IONOGRAM DATA REDUCTION
• 1612	GROSSMAN, P.	CASCO	KOSSEY, P.	LIF	4503	HARMONIC ANALYSIS OF REFLECTED RADIO WAVE
• 1612A	GROSSMAN, P.	DAPCC	KOSSEY, P.	LIF	4503	HARMONIC ANALYSIS OF REFLECTED RADIO WAVE
• 1613	WIGGINS, F.	ACSI	CONOVER, J.	LYS	6698	SEA LEVEL PRESSURE DATA ANALYSIS
• 1614	CONWAY, F.	ACSI	SLOBODNIK, A.	LZM	5635	CALCULATION OF SURFACE WAVE VELOCITY ON CRYSTAL SUBSTRATES
• 1615	SPLAIA, A.	ACSI	CORMIER, R.	LIT	5631	ATOMETER DATA PLOTS
• 1616	MATTIO, V.	GOV	WYNGAARD, J.	LYB	7655	MEASUREMENT OF WIND FORCE AND VELOCITY
• 1617	GROSSBARD, N.	EC	MOORE, J.	LKA	7661	PULSATING AURORA

Exhibit 5A (Cont)

LEGEND

SYMBOL	COMPANY
ACSI	Analysis & Computer Systems, Inc.
ARCON	Arcon Corporation
BC	Boston College
DABCO	Dabcovich & Company, Inc.
DPSI	Digital Programming Services, Inc.
EAI	Electronic Associates Incorporated
GC	General Computing Services, Inc.
GOV	Government
HARV	Harvard University
LOG	Logicon, Inc.
LTI	Lowel Technological Institute
MARTIN	Martin Marietta Corp.
PH	Phillip Hankins & Company
RE CAL	Research Calculations
RDP	RDP, Inc.
TMG	The Management Group
WOLF	Wolf Research & Development Corp.
WPI	Worcester Polytechnic Institute

Exhibit 5B

PREPARED BY/FOR THE ANALYSIS AND SIMULATION BRANCH (SUYA), AIR FORCE CAMBRIDGE RESEARCH LABORATORIES, TEL. 861-4161

PROJECT/PROBLEM LIBRARY INFORMATION LIST
STATUS - ALL PROBLEMS BELOW ARE COMPLETED
LISTED BY PROBLEM NUMBER

PROB. NO.		PROGRAMMER	COMPANY	INITIATOR	LAB	PROJ. NO.	TITLE
* 4514	9	AUCLAIR, C.	BC	PHILBRICK, C.	LKO	6687	OV1-21 DATA REDUCTION
* 4514	10	ATKINSON, J.	ACSI	PHILBRICK, C.	LKO	6687	OV3-6 DATA MERGE
* 4515	1	TRENT, P.	BC	PRICE, S.	OPI	8692	BRIGHTNESS AND DIRECTION OF VISIBLE OBJECTS IN SPACE
* 4515	2	TRENT, P.	BC	PRICE, S.	OPI	8692	PROJECT HI-STAR--DETECTED SOURCES POSITION UPDATE
* 4517	1	DELOREY, D.	BC	SANDOCK, J.	LIJ	7663	MISCELLANEOUS PROBE FOR ROCKET AJ17.986-1
* 4520	1	DELOREY, D.	BC	ULWICK, J.	LIJ	7663	LANGMUIR PROBE--ROCKET NO. AJ17.617
* 4520	2	DELOREY, D.	BC	ULWICK, J.	LIJ	7663	LANGMUIR PROBE--ROCKET NO. AJ17.986
* 4520	3	DELOREY, D.	BC	ULWICK, J.	LIJ	7663	LANGMUIR PROBE--ROCKET NO. AJ17.602
* 4520	4	DELOREY, D.	BC	ULWICK, J.	LIJ	7663	LANGMUIR PROBE--ROCKET NO. AJ17.758
* 4520	5	DELOREY, D.	BC	ULWICK, J.	LIJ	7663	LANGMUIR PROBE--ROCKET NO. AJ17.616
* 4520	6	DELOREY, D.	BC	ULWICK, J.	LIJ	7663	SCINTILLATOR PROBE
* 4520	7	DELOREY, D.	BC	ULWICK, J.	LIJ	7663	PROTON DETECTOR MAGNETIC PITCH ANGLE FOR ROCKET AJ17.617
* 9800	1	MULTIPLE AUTHORS	MPI	CRONIN, E.	SUYA	6301	HYBRID SPECTRAL ANALYSIS
* 9802	1	FASANO, J.	GOV	PAULSEN, E.	LYN	6690	SPECIALIZED SIGNAL ANALYSIS
* 9803	1	FASANO, J.	GOV	WEEKS, L.	LKB	6690	EVALUATION OF ROCKET DATA NOISE
* 9804	1	FASANO, J.	GOV	GOOD, C.	LKC	7635	REDUCTION OF DATA FROM FILTER WHEEL RADIOMETER
* 9805	1	MULTIPLE AUTHORS	EAI	CRONIN, E.	SUYA	6301	ORBITING VEHICLE SIMULATION
* 9806	1	MULTIPLE AUTHORS	MARTIN	CRONIN, E.	SUYA	6301	ORBITING VEHICLE SIMULATION
* 9807	1	FASANO, J.	GOV	FANTE, R.	LZP	5635	ANALOG SIMULATION OF TRANSMISSION THROUGH A TIME-VARYING LAYER
* 9812	1	MULTIPLE AUTHORS	EAI	CRONIN, E.	SUYA	6301	ANALYSIS OF IONOSPHERIC RAY TRACING
* 9812	1	MULTIPLE AUTHORS	MARTIN	CRONIN, E.	SUYA	6301	ANALYSIS OF IONOSPHERIC RAY TRACING

Exhibit 5B (Cont)

Analysis and Simulation Branch Library Problem Request

Request was submitted this date ____________ for _____ copy(s) of:

Documentation ( )
Dock(s) ( )
Listing(s) ( )
Other (Specify) ( )

Program Name:
Account No.:
Problem No.:

Requester:
Lab or Branch:
Ext. No.:

____
(Signature of Requester)

The above information was furnished requester.

____
(Signature of Library (CUL) Representative (Date)

Exhibit 6

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****************************************
*   LIBRARY UTILIZATION STATUS REPORT   *
*              PREPARED BY               *
*  THE ANALYSIS AND SIMULATION BRANCH    *
*        PROJECT/PROBLEM LIBRARY         *
*             ON 06/06/72                *
****************************************
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Exhibit 7

LIBRARY UTILIZATION STATUS REPORT PREPARED BY THE ANALYSIS AND SIMULATION BRANCH PRODUCT/PROGRAM LIBRARY ON PAGE 2

DATE REQUESTED	REQUESTOR	DEPT/COMPANY	ACCOUNT	PROBLEM	MOD	WORK UNIT	NO OF COPIES	DOC	DECK	LIST	DATE SUPPLIED	PROGRAM NAME	CATEGORY
14JUL71	NEXLER,R.	CUTSIC	1694				1	X	X	X	14JUL71	THICKNESS	4
14JUL71	NEXLER,R.	CUTSIC	1614				1	X	X	X	14JUL71	WAVES	1,4
14JUL71	NEXLER,R.	CUTSIC	1688				1	X	X	X	14JUL71	IONOGRAM	1,4
14JUL71	NEXLER,R.	CUTSIC	1687				1	X	X	X	14JUL71	FILMS	4
14JUL71	NEXLER,R.	CUTSIC	1689				1	X	X	X	14JUL71	ATA 1	4
12AUG71	ARMSTRONG,C.	ACSI	1527		A		2	X			12AUG71	AZIM1	5
13AUG71	ARMSTRONG,C.	ACSI	1680		A		1	X	X	X	13AUG71	UPDATE	4
17AUG71	PRICE,W.	SUCL	1680		A		1	X	X	X	17AUG71	UPDATE	4
23AUG71	ROBBINS,H.	SLVA	1784		T		1		X		24AUG71	L2ECIT	2
20AUG71	CROSSEARD,N.	EC	1748				1	X		X	2SEP71	CROSS-CORR	1
20AUG71	CARECHE,W.	ACSI	1408		A		1	X	X	X	2SEP71	BURST	1,4
20AUG71	ROSSIMOLO,R.	FHS	1407				1	X	X		2SEP71	M PATROL	1,4
20AUG71	ROSSIMOLO,R.	FHS	1408				1	X	X		2SEP71	RADOF	1,4
20AUG71	ROSSIMOLO,R.	FHS	1409				1	X	X		2SEP71	SPASS	1,4
20AUG71	ROSSIMOLO,R.	FHS	1407				1	X	X		2SEP71	FLARE	1,4
20AUG71	ROSSIMOLO,R.	FHS	1407				1	X	X		2SEP71	SUNSPOT	1,4
20AUG71	ROSSIMOLO,R.	FHS	1407				1	X	X		2SEP71	PLACE	1,4
20AUG71	ROSSIMOLO,R.	FHS	1407				1	X	X		2SEP71	SOLREC	1,4
20AUG71	ROSSIMOLO,R.	FHS	1407				1	X	X		2SEP71	UPDATE2	1,4
20AUG71	ROSSIMOLO,R.	FHS	1407				1	X	X		2SEP71	SORT	1,4
20AUG71	ROSSIMOLO,R.	FHS	1407				1	X	X		2SEP71	HISTRY	1,4
20AUG71	ROSSIMOLO,R.	FHS	1407				1	X	X		2SEP71	SOLSUP	1,4
20AUG71	ROSSIMOLO,R.	FHS	1407				1	X	X		2SEP71	CLASI	1,4
20AUG71	ROSSIMOLO,R.	FHS	1407				1	X	X		2SEP71	SOLRCT	1,4
20AUG71	ROSSIMOLO,R.	FHS	1408				1	X	X		2SEP71	SHEEP	1,4
20AUG71	ROSSIMOLO,R.	FHS	1408				1	X	X		2SEP71	BURST	1,4
20AUG71	ROSSIMOLO,R.	FHS	1409				1	X	X		2SEP71	SUNRCT	1,4
1SEP71	CROSSEARD,N.	EC	1615				1		X	X	8SEP71	MOORE	1
8SEP71	HUSSEY,T.	SLVA	1726				1		X		8SEP71	PLTI2	2
10SEP71	CROSSEARD,N.	EC	1453				1	X			10SEP71	CF COFFELT	1
14SEP71	WHELAN,C.	CAECC	1259				1	X			14SEP71	LINEAR SEP	1,4
15SEP71	CROSSEARD,N.	EC	1452		A		1	X			15SEP71	SET TAPE7E	1
15SEP71	CROSSEARD,N.	EC	1452		E		1	X			15SEP71	SET TAPE7A	1
15SEP71	CROSSEARD,N.	EC	1452		I		1	X			15SEP71	SET TAPE7C	1
15SEP71	CROSSEARD,N.	EC	1452		R		1	X			15SEP71	CALCULATE	1
16SEP71	FOLEY,C.	SLVA	1162		E		1	X			16SEP71	CSC 1970	1
16SEP71	PAZZIC,V.	SLVA	1724				2	X			16SEP71	LPS DATA	1
27SEP71	LUNT,T.	LPI	1679				1	X	X	X	20SEP71	REL PRECL	1,4
29SEP71	SZABO,T.	LZP	1571				1		X		1OCT71	FAST FOURIE	1
5OCT71	VICKSELL,F.	EC	1417				1		X		12OCT71	NF PHASE	1
12OCT71	HUSSEY,T.	SLVA	1725				1	X	X		14OCT71	ECLIPSE	1
14OCT71	CCCC,E.	LNC	4001	01			1	X	X		14OCT71	CIG.CON.SCF	4
15OCT71	PRICE,S.	CFI	4515	01			1	X	X	X	18OCT71	TAL	5
18OCT71	CROSSEARD,N.	EC	1052				1	X			18OCT71	FIOCH CLMP	1
27OCT71	MCINERNEY,R.	SLVA	1157				1	X			27OCT71	NEW INVAR	2,5
4NOV71	ELKINS,T.	LJB	1214				1		X		8NOV71	KCNTCF	2
11NOV71	FOLEY,C.	SLVA	1022				1	X			11NOV71	LF ATMOSP	4
11NOV71	FOLEY,C.	SLVA	1189				1	X			11NOV71	COSMIC NOIS	
11NOV71	FOLEY,C.	SLVA	1463				1	X			11NOV71	DE FLCT	4
11NOV71	FOLEY,C.	SLVA	1615				1	X			11NOV71	DE 111	4
18NOV71	FOLEY,C.	SLVA	1347				1	X	X	X	18NOV71	SIFT	4
18NOV71	FOLEY,C.	SLVA	1728				1	X	X	X	22NOV71	AESP	1

Exhibit 7 (Cont)

Appendix A

Index by Technical Keyword (Pages 94-159)

Arranged on the left-hand side of each page, the reader will find an alphabetical listing of the significant technical keywords for each given problem effort. This will enable the reader to select individual problem abstracts (contained in Appendix D) of particular interest.

The problem numbers (synonymous with abstract numbers) corresponding keywords are listed in numerical order from left to right on the same line.

Use of Appendices A, B, or C should allow the reader to secure information in any area of interest contained in this data base of completed problem efforts.

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ABSOLUTE GAMMA UNITS	1248							
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ACOUSTIC RAYS	3032/02							
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AERODYNAMICS	1490							
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	1200	1210	1212	1213	1214	1218	1225	1227
	1229	1231	1240	1242	1244	1245	1246	1248
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	1510	1513	1519	1526	1527	1535	1536	1538
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	4004/01	4004/02	4005/01	4017/01	4017/02	4503/02	4514/05	
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AEROSOL ATTENUATION	1392	1424	1466	3034/01				
AEROSOL CHEMISTRY	3034/01							

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AEROSOL MEASUREMENT	1161							
AEROSOL PROPERTIES	1079	1466						
AEROSPACE INSTRUMENTATION	1075	1127	1490					
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	3014/02	4009/02						
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Appendix B

Index by Keywords in Problem Task Title (Pages 163-235)

Arranged on the left-hand side of each page, the reader will find an alphabetical listing of the salient keywords of each given problem title. This will enable the reader to select problem abstracts of particular interest.

The problem number (synonymous with the abstract number) for the corresponding abstract (contained in Appendix D) is noted in the same line on the right-hand side of the page.

Use of Appendices A, B, or C should allow the reader to secure information in any area of interest contained in this data base.

Part I – Completed Problem Efforts Prior to 1 July 1971 (Pages 163-216)

Prior to 1 July 1971, all elements in the Customer User Library (CUL) were stored in numerical order. Each element was then given a "Category Tag" of one through five to denote its primary responsibility as assigned to a Branch Section (see Text, Section 3, Functional Organization).

Part II – Completed Problem Efforts After 1 July 1971 (Pages 217-235)

As of 1 July 1971, the above system has been ameliorated so that the area of prime responsibility is noted by the assignment of a series of numbers. "Category tags" are no longer necessary.

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JET	JET PROPULSION LAB, EPHEMERIS PROCESSING SYSTEM	1?4A

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LAYER	ABSORPTION THROUGH A CHAPMAN LAYER	[illegible]
LEAST	LEAST SQUARES FIT	[illegible]
LEAST-SQUARES	SOLAR SPECTRAL IRRADIANCE STUDY BY LEAST-SQUARES CURVE FITTING	[illegible]
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WIND	WIND VELOCITY-- BALLOON TRAJECTORY ANALYSIS	11248
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WIRES	ELECTR MAGNETIC BACK-SCATTERING OF CROSSED WIRES	1358
WORLD	PLOT OF GEOGRAPHIC COORDINATES ON A WORLD MAP	154[illegible]

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KEYWORD	TITLE	PROBLEM NUMBER
YIELD	IONIZATION YIELD OF NITROGEN	111.

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KEYWORD	TITLE	PROBLEM NUMBER
Z-THETA	Z-THETA PROBE DATA REDUCTION	1209
ZENITH	SOLAR ZENITH ANGLE PLOTS	1462

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AD21.862	ELECTROSTATIC PROBE ON ROCKET AD21.862	4507 01
AIRCRAFT	CALCULATION OF SATELLITE AND AIRCRAFT FLIGHT TRACKS	351A 02
AJ17.682	LANGMUIR PROBE--ROCKET NO. AJ17.682	4520 03
AJ17.682	GERDIEN CONDENSOR FOR ROCKET NO. AJ17.682	4585 05
AJ17.616	LANGMUIR PROBE--ROCKET NO. AJ17.616	4520 05
AJ17.617	LANGMUIR PROBE--ROCKET NO. AJ17.617	452C 01
AJ17.617	GERDIEN CONDENSOR FOR ROCKET NO. AJ17.617	45C5 03
AJ17.617	PROTON DETECTOR MAGNETIC PITCH ANGLE FOR ROCKET AJ17.617	4520 07
AJ17.753	GERDIEN CONDENSOR FOR ROCKET NO. AJ17.758	4505 06
AJ17.757	GERDIEN CONDENSOR FOR ROCKET NO. AJ17.757	4505 01
AJ17.758	LANGMUIR PROBE--ROCKET NO. AJ17.758	4528 04
AJ17.759	GERDIEN CONDENSOR FOR ROCKET NO. AJ17.758	4505 04
AJ17.905	LANGMUIR PROBE--ROCKET NO. AJ17.906	452C 02
AJ17.905-1	AMPULLACEOUS PROBE FOR ROCKET AJ17.906-1	1517 01
AJ17.905-1	GERDIEN CONDENSOR FOR ROCKET NO. AJ17.906-1	4505 02
AMPULLACEOUS	AMPULLACEOUS PROBE FOR ROCKET AJ17.906-1	1517 01
ANALOG	ANALOG SIMULATION OF TRANSMISSION THROUGH A TIME-VARYING LAYER	4087 01
ANALYTICAL	ANALYTICAL ANALYSIS OF ICE CYLINDER RAINBOW - SUPERNUMERARIES	303C 02
ANGLE	PROTON DETECTOR MAGNETIC PITCH ANGLE FOR ROCKET AJ17.617	4520 07
ANTENNAS	ADMITTANCE PARAMETERS, PLASMA-COVERED CAVITY-BACKED SLOT ANTENNAS	302E 02
ARCHIVES	SETUP AND MAINTENANCE OF ORBITAL ARCHIVES	35C4 01
ASTRODATA	ASTRODATA TAPE UNPACK	4501 01
ATMOSPHERE	FLUCTUATIONS OF RADIO SIGNALS IN THE ATMOSPHERE	3014 02
ATMOSPHERE	ANALYSIS OF UPPER ATMOSPHERE WIND DATA	302A 02
ATMOSPHERE	ANALYSIS OF UPPER ATMOSPHERE WIND DATA--MODIFICATION	3028 02
ATMOSPHERIC	CALCULATION OF ATMOSPHERIC DENSITIES--ORBIT DETERMINATION	3501 05
ATMOSPHERIC	ATMOSPHERIC OPTICAL ATTENUATION MODEL	402C 01
ATMOSPHERIC	ATMOSPHERIC TURBIDITY	3024 01
ATTENUATION	CORRELATION OF REFLECTIVITY AND ATTENUATION	3021 01
ATTENUATION	ATMOSPHERIC OPTICAL ATTENUATION MODEL	4020 01

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BEAM	DIFFRACTION PATTERN OF LASER BEAM THROUGH CYLINDRICAL WINDOW	2010 02
BRANCH	ANALYSIS AND SIMULATION BRANCH PROJECT/PROBLEM LIBRARY	0010 01
BRANT	BLACK BRANT ROCKET TRAJECTORY POSITION DATA ANALYSIS	3525 01
BULK	BULK WAVE IN A CRYSTAL	4806 04

KEYWORD	TITLE	PROBLEM NUMBER
CANNONBALL	CANNONBALL AND MUSKETBALL SATELLITE DATA PLOTS	4017 01
CANNONBALL	DETERMINATION OF DRAG ON CANNONBALL II	3027 01
CANNONBALL	CANNONBALL II PRELAUNCH DEVELOPMENT	3586 01
CANNONBALL	CANNONBALL II TELEMETRY DATA PROCESSING	4583 02
CANNONBALL-MUSKETBALL	CANNONBALL-MUSKETBALL SATELLITE DATA PLOT MODIFICATION	4017 02
CAVITY-BACKED	ADMITTANCE PARAMETERS, PLASMA-COVERED CAVITY-BACKED SLOT ANTENNAE	3026 02
CIRCUMSTANCES	PREDICTION OF ECLIPSE CIRCUMSTANCES	3501 04
CLIMATIC	CLIMATIC AIDS FOR WEATHER FORECASTERS	4084 01
CLOUD	CLOUD INTENSITY ANALYSIS	4002 02
CLOUD	ANALYSIS OF CLOUD INTENSITY OVER INDIA	4002 06
CLOUDINESS	CLOUDINESS PROBABILITY DETERMINATION--PROJECT COLUMBIA	4004 02
COLUMBIA	CLOUDINESS PROBABILITY DETERMINATION--PROJECT COLUMBIA	4004 02
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CONDENSOR	GERDIEN CONDENSOR FOR ROCKET NO. AJ17.617	4505 03
CONDENSOR	GERDIEN CONDENSOR FOR ROCKET NO. AJ17.750	4505 06
CONDENSOR	GERDIEN CONDENSOR FOR ROCKET NO. AJ17.757	4505 01
CONDENSOR	GERDIEN CONDENSOR FOR ROCKET NO. AJ17.758	4505 04
CONDENSOR	GERDIEN CONDENSOR FOR ROCKET NO. AJ17.986-1	4505 02
CONTOUR	CONTOUR PLOTTING	3801 01
COORDINATE	LUNAR COORDINATE REFINEMENT	3032 01
COORDINATES	COMPUTATION OF HELIOGRAPHIC COORDINATES	3501 06
COORDINATES	CORRECTION OF GEOMAGNETIC COORDINATES AND GEOMAGNETIC TIME	3508 01
COORDINATES	CORRECTED GEOMAGNETIC COORDINATES INVERSION	3508 02
CORRECTION	CORRECTION OF GEOMAGNETIC COORDINATES AND GEOMAGNETIC TIME	3508 01
CORRELATION	CALCULATION OF WIND PARAMETER CORRELATION COEFFICIENTS	4002 05
CORRELATION	CORRELATION OF REFLECTIVITY AND ATTENUATION	3021 01
CRYSTAL	BULK WAVE IN A CRYSTAL	4006 04
CRYSTALS	SURFACE WAVE CHARACTERISTICS ON CRYSTALS	4006 09
CRYSTALS	SURFACE WAVE PHENOMENA ON PIEZOELECTRIC CRYSTALS	4006 07
CYLINDER	ANALYTICAL ANALYSIS OF ICE CYLINDER RAINBOW - SUPERNUMERARIES	3036 02
CYLINDRICAL	DIFFRACTION PATTERN OF LASER BEAM THROUGH CYLINDRICAL WINDOW	2010 02

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KEYWORD	TITLE	PROBLEM NUMBER
DENSITIES	CALCULATION OF ATMOSPHERIC DENSITIES--ORBIT DETERMINATION	3583 05
DETECTOR	PROTON DETECTOR MAGNETIC PITCH ANGLE FOR ROCKET AJ17.617	4528 07
DIFFRACTION	SCALAR DIFFRACTION PATTERN CALCULATION	7010 01
DIFFRACTION	DIFFRACTION PATTERN OF LASER BEAM THROUGH CYLINDRICAL WINDOW	3011 02
DIGITIZED	DIGITIZED IONOSPHERIC DATA CHECK	4015 01
DISTRIBUTION	PROBABILITY DISTRIBUTION OF MINIMUM GAUSSIAN VALUE--METEOROLOGY	3817 0[illegible]
DISTRIBUTION	PROBABILITY DISTRIBUTION OF SPATIAL MINIMA IN TWO DIMENSIONS	3017 02
DRAG	DETERMINATION OF DRAG ON CANNONBALL II	3027 01
DYNAMIC	DYNAMIC MODEL OF THE THERMOSPHERE	3041 01

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KEYWORD	TITLE	PROBLEM NUMBER
EARTH	MEASUREMENT OF EARTH TIDES	4012 01
ECLIPSE	PREDICTION OF ECLIPSE CIRCUMSTANCES	3551 06
ECLIPSE	DETERMINATION OF ECLIPSE PARAMETERS	3527 01
EDITING	INTERACTIVE GRAPHICS GENERAL EDITING	4510 06
ELECTROMAGNETIC	ELECTROMAGNETIC WAVES IN A MAGNETOPLASMA	3077 01
ELECTRON	IONOSPHERIC TOTAL ELECTRON CONTENT MEASUREMENTS	4031 01
ELECTROSTATIC	ELECTROSTATIC PROBE ON ROCKET A021.862	4587 01
ENTRAINMENT	HARMONIC ENTRAINMENT OF VAN DER POL OSCILLATIONS	[illegible] 01
EPHEMERIS	ORBIT DETERMINATION AND EPHEMERIS COMPUTATION	3585 01
EVALUATION	EVALUATION OF ROCKET DATA NOISE	4023 01
EXCITED	DETERMINATION OF THE MEAN LIFETIME OF EXCITED STATES OF IONS	3067 01

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KEYWORD	TITLE	PROBLEM NUMBER
FIELD	ION PARTICLE MOTION IN A TORMAC MAGNETIC FIELD	3046 01
FILTER	REDUCTION OF DATA FROM FILTER WHEEL RADIOMETER	90C[illegible] 01
FLIGHT	CALCULATION OF SATELLITE AND AIRCRAFT FLIGHT TRACKS	3568 03
FLUCTUATIONS	FLUCTUATIONS OF RADIO SIGNALS IN THE ATMOSPHERE	3714 02
FORECASTERS	CLIMATIC AIDS FOR WEATHER FORECASTERS	4004 01

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GAUSSIAN	PROBABILITY DISTRIBUTION OF MINIMUM GAUSSIAN VALUE--METEOROLOGY	3017 03
GE-625	GE-625 COMPUTER TAPE CONVERSION	4088 02
GE-625	GE-625 COMPUTER TAPE CONVERSION - MODIFICATION	4088 02 A
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INDIA	ANALYSIS OF PRECIPITATION OVER INDIA	4002 07
INDIA	ANALYSIS OF CLOUD INTENSITY OVER INDIA	4002 06
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INVERSION	CORRECTED GEOMAGNETIC COORDINATES INVERSION	3568 02
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IONOSPHERIC	DIGITIZED IONOSPHERIC DATA CHECK	4819 01
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IONS	DETERMINATION OF THE MEAN LIFETIME OF EXCITED STATES OF IONS	2067 01
IRREGULARITIES	ANALYSIS OF IONOSPHERIC IRREGULARITIES	3014 01

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LANGMUIR	LANGMUIR PROBE--ROCKET NO. AJ17.617	4520 01
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Appendix C

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The following index lists the tasks which have been undertaken by the specific AFCRL Laboratory and Branch from which the initiator came.

The reference noted is a problem number which can be reviewed in referencing Appendix D (numerical order) where all relevant information is available.

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		1121	1391	1512
Dynamics	1010	1492		
Direct Sensing Techniques	--			
Meteorology Observing Techniques	--			
Stratiform Cloud Physics	1306			
Satellite Meteorology	1070	1221D	1469	4002-1
	1105	1221E	1551	4002-2
	1221	1221F	1562	4002-3
	1221A	1312	1579	4002-5
	1221B	1346	1596	4002-6
	1221C	1373	1613	4002-7
Upper Atmosphere	1056	1135A	1451	
	1057	1180	1475	
	1135	1305	1531	
Vertical Sounding Techniques	--			
Weather Radar	1130	1279	1488	3021-1
	1178	1344	1565	3021-2
	1224	1474	1565A	9002-1
	1266			

MICROWAVE PHYSICS LABORATORY (LZ)

Electromagnetic Sensors	1264	1528	
	1358	1597	
Microwave Acoustics	1074	1522	1570
	1147	1522A	1614

MICROWAVE PHYSICS LABORATORY (LZ) (Cont)

Millimeter Wave	1046	1243	1405	4006-7
	1155	1247	1504	4006-9
	1174	1249	4006-3	
	1193	1304	4006-4	
Plasma Electromagnetics	1239	1550	3026-1	
	1334	1550A	3026-2	
	1369	1550B	3037-1	
	1400	1550C		
Radiation and Reflection	1143			

OPTICAL PHYSICS LABORATORY (OP)

Atmospheric Optics	1012	1141	1268	1466
	1013	1145	1392	1466A
	1079	1161	1424	1515
	1111	1185	1424A	1576
	1136	1265	1427	3034-1
Infrared Physics	1036	1191	1502	4515-1
	1037	1284	1567	4515-2
	1042	1398	1567A	
	1133	1500	1577	
Laser Physics	--			
Radiation Effects	1059	1091A	1357	1491
Molecular Physics	1091	1283	1456	
Radiometry	--			

SPACE PHYSICS LABORATORY (PH)

Space Physics	1039	1226		
Solar Plasma Dynamics	1281	1401	1419	1595
	1335	1418	1501	1598

SPACE PHYSICS LABORATORY (PH) (Cont)

Energetic Particles	1001	1238	1329	1429
	1071	1250	1352	1433
	1146	1280	1372	1450
	1156	1292	1383	1485
	1164	1301	1390	1540
	1165	1327	1425	1606
	1203			
Energy Converson	1022	1296A	1345A	1552
	1097	1296B	1345B	
	1115	1345	1345C	
	1296			
Geomagnetism	1090	1315	1523	
	1150	1421	1547	
	1251	1421A	1605	
Spectroscopic Studies	1153			
Plasma Physics	1333			
Space Forecasting	--			

AFCRL COMPUTATION CENTER (SUY)

Analysis and Simulation	1011	1211	1326	1407I
	1026	1232	1348	1407J
	1027	1236	1355	1408A
	1028	1236A	1366	1408B
	1029	1277	1368	1408C
	1034	1298	1370	1408D
	1083	1302	1407A	1409A
	1107	1314	1407B	1409B
	1131	1314A	1407C	1409C
	1139	1314B	1407D	1410
	1139A	1314C	1407E	1411
	1139B	1314D	1407F	1413
	1158	1322	1407G	1414
	1170	1322A	1407H	1416A
	1183	1324		

OPERATIONAL SERVICES (SUO)

Research Library	1447	1447A

Appendix D

Problem Abstracts (Pages 248-626)

Part I – Prior to 1 July 1971 (Pages 248 - 562)

Prior to 1 July 1971, all elements in the Customer User Library (CUL) were stored in numerical order. Each element was then given a "Category Tag" of one through five to denote its primary responsibility as assigned to a Branch Section (see Text, Section 3, Functional Organization).

Part II – After 1 July 1971 (Pages 563 - 626)

As of 1 July 1971, the above system has been ameliorated so that the area of prime responsibility is noted by the assignment of a series of numbers. "Category tags" are no longer necessary.

Technical Section	Account	Problem Nos.	Pages
1. Mathematical Analysis	3000's	1-99	564
2. Orbital Determination and Operations	3500's	1-99	579
3. Analog/Hybrid Analysis	9000's	1-99	586
4. Non-Numeric Systems	4000's	1-99	591
5. Rocket/Satellite Data Analysis	4500's	1-99	612

TITLE: Quick-Look OV2-1
AUTHOR: Dabcovich, M.

INITIATOR: Smart, D. (PHE)
PROJECT: 8600 PROBLEM NO. 1001

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 77_8k

OV2-1 was a satellite carried into orbit on a Titan 3 vehicle and released in a nominal 400 X 4000 mile orbit with approximately a 30° inclination. OV2-1 telemetry data tapes acquired through the Data Reduction Facility at Northeastern University contained ephemeris data taken from one channel of the satellite's transmission. The computer program "Quick Look" reads these tapes as they were digitized by Northeastern University and generates reports. It is designed to:

(a) read the complete range time file
(b) make two lists:
   (1) range times
   (2) clock times
(c) read down range times and make a list of discontinuities
(d) read down clock times and make a list of discontinuities
(e) generate a new list of corrected clock times
(f) generate a new list of corrected range times
(g) generate a new list of universal times

TITLE: OGO Telemetry Data Processing
AUTHOR: Bacon, D.

INITIATOR: Bedo, D. (LKO)
PROJECT: 6688 PROBLEM NO. 1002

HARDWARE/SOFTWARE: IBM 7044/Fortran IV, MAP
MINIMUM CORE SIZE: 21_8k

A computer program was written to process telemetry data from digital data tapes acquired from the Orbiting Geophysical Observatory (OGO) satellite. Although the satellite contained instrumentation to perform a number of experiments, the computer effort here was intended to process data pertaining to experiment 50-20 only.

The data associated with experiment 50-20, which was deciphered and displayed by this program, consists of photon count information transmitted via telemetry from the spacecraft and then converted in the form of digital tapes. These data tapes received and preprocessed by Goddard Space Flight Center (Greenbelt, Maryland) and used as input to the computer program, must observe prescribed formats. The input data may reflect real-time transmissions for any of three bit rates, namely 4, 16 or 64 kilobits per second or it may consist of playback recorded data with a recorded bit rate of 4 kilobits per second.

Standards on the general form of these tapes have also been established. Although a data tape may consist of more than one file, each file will have data of the same kilobit rate, with playback data always kept on a separate file from real-time telemetry. Furthermore, all data found in a given file will be the result of telemetry received from only one ground station pass.

TITLE:	Van Der Pol Plots	
AUTHOR:	Persakis, T.	
INITIATOR:	Safonov, M. (LRA)	
PROJECT:	5632	PROBLEM NO. 1003
HARDWARE/SOFTWARE:	IBM 7094II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	40_8k	

Program "Van Der" was written to plot resonance curves of a Van Der Pol type oscillator. In the program, parameters R and G are read from a card; and σ is determined and plotted as a function of ρ. The domain of the function σ is $.005 < \rho < 2$, and the interval between successive ρ points is entered as data in the main program. For plotting, the σ range was restricted to $0 < \sigma < 5$. A separate plot is drawn for each value of R, with the σ values for the several values of G superimposed.

$$\rho = \frac{a^2}{\rho_1}$$

where a = the response amplitude of Van Der Pol, and ρ_1 and ρ_2 = the squares of the limit cycle amplitudes of an autonomous equation. This program will calculate the equations only for the calculated six (6) G's. To make other calculations the constants must be changed.

TITLE:	OV1-15 MS I & IV Neutral Pressure Data Conversion	
AUTHOR:	Desrochers, R.	
INITIATOR:	Philbrick, R. (LKD)	
PROJECT:	6687	PROBLEM NO. 1004
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	77_8k	

MS I & IV mass peak data from the OV1-15 satellite is converted to pressure, and a plot of each mass vs time is produced. The ambient neutral gas temperature is calculated.

The input consists of (1) a data file containing IMS, ephemeris, and aspect data, and (2) control cards designating masses of interest, variables for the calculation of the gas temperature, amps/mm conversion table, and coefficients for computing the internal temperature.

The output consists of a listing of mass peaks in pressure form and a plot of each mass (pressure vs GMT).

TITLE: Eigenvalue Problem - Homogeneous Set of Equations
AUTHOR: Tsipouras, P.

INITIATOR: Eyges, L. (LQD)
PROJECT: 5621 PROBLEM NO. 1005

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 20_8k

This problem concerned an improved method for quantum mechanical four-body problems. The problem was described by a set of infinite equations with infinite unknowns F(e,m):

$$\frac{2\pi^2}{2} F(e,m) = F(e,m) \sum_{n=-\infty}^{\infty} \frac{\Delta(n,e+m)}{E-4(n^2+3e^2+3m^2+2em}$$

$$+ \sum_{n=-\infty}^{\infty} \frac{2F(n,m) + 2F(n,e) + F(n,-n-e-m)}{E-4(e^2+m^2+n^2+nm+ne+em)}$$

where e and m are integers, positive or negative, which satisfy the following conditions:

$$F(e,m) = F(m,e) = F(-e,-m) = F(-m,-e)$$

These are the conditions of F.

TITLE: Satellite Position and Scintillation Analysis
AUTHOR: Forni, A.

INITIATOR: Klobuchar, J. (LIR)
PROJECT: 4643 PROBLEM NO. 1006

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 63_8k

Satellite S-66 data from a library of station information was processed in an attempt to provide in FORTRAN a general purpose version of the B3 system ephemeris routine. The routine was split into time-dependent and time-nondependent quantities for flexibility of application; and, thus, eliminated redundancy of calculations when processing several satellites at once and updating all of them to the same time. Data cards were analyzed in either 6 or 7 card space-track K25 element sets and a conversion factor to universal time for the given station location was specified by a code on the data cards. The position of the satellite with regard to latitude, longitude and altitude was calculated, and necessary constants for completion of the version of the B3 system ephemeris routine were calculated from an incorporated "Generalized Field Program." Zero drag was assumed.

TITLE: OV1-15 Exospheric Temperature
AUTHOR: Erickson, P.

INITIATOR: Philbrick, C. (LKD)
PROJECT: 6687 PROBLEM NO. 1007

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 60_8k

The exospheric temperature encountered by the OV1-15 satellite is determined through the use of the MS II neutral hydrostatic equation. Values representing changes in vehicle altitude of five kilometers are interpolated. These values are local time, latitude, longitude, and aspect (angle of attack). The interpolation is a Lagrangian interpolation on either linear, non-angular values or linear angular values.

Next, an initial gravity value and initial values for interior temperature and pressure are calculated. The hydrostatic equation is then used to compute the exospheric temperature for the present altitude.

When the temperatures have been found for each five-kilometer change in altitude, they are plotted against altitude.

TITLE Correction of Laser Measurements for Tropospheric Refraction
AUTHOR: Persakis, T.

INITIATOR: Hadgigeorge, G. (LWG)
PROJECT: 7600 PROBLEM NO. 1008

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 15_8k

Laser data measured at AFCRL by the LWG Dual Model Ruby Laser to geodetic satellites carrying reflectors was corrected. These measurements were used for updating satellite ephemeris and determining accurate station positions.

Date and time were given along with the uncorrected range measurement. A formula which used input values for satellite altitude, range values in meters, atmospheric pressure in millibars, temperature in degrees kelvin, and laser's elevation above mean sea level in kilometers performed the atmospheric correction for tropospheric refraction.

Temperature, pressure and elevation were listed, and station, date, number of sets, and some intermediate values were both listed and punched on cards.

TITLE: Z-theta Probe Data Reduction
AUTHOR: Delorey, D.

INITIATOR: Ulwick, J. (LIJ)
PROJECT: 7663 PROBLEM NO. 1009

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 60_8k

The Z-theta probe is an instrument flown aboard rockets for the determination of electron density. Two operating frequencies, 3 MHz and 7.2 MHz, are used on the probe, and the results from these frequencies are obtained.

Values of antenna impedance are calculated and plotted. After examination of the plots, a value of free space reactance is chosen and this value is used to obtain and plot the values of electron density vs time and altitude.

TITLE: Power Spectral Analysis
AUTHOR: Martine, J.

INITIATOR: Toman, K. (LII)
PROJECT: 5631 PROBLEM NO. 1010

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 32_8k

The purpose of this task was to develop a program to calculate auto-correlation and cross-correlation coefficients for given data as outlined in the application discussion on "Autocorrelation and Spectral Analysis" in Chapter 19 of Ralston & Wilf's edition of Mathematical Methods. The program will calculate a negative and positive lag in cross-correlating with the number of data constants for lags in cross-correlation. Auto and cross-correlations were calculated for a particular lag p as:

$$r_p = \frac{(N-p)\ \Sigma x_i x_{i+p} \qquad\qquad (\Sigma x_i\ \Sigma x_{i+p})}{\sqrt{(N-p)\ \Sigma\ (x_i^2) - (\Sigma\ x_i)^2}\ \left(\sqrt{(N-p)\ \Sigma\ (x_{i+p}^2) - (\Sigma x_{i+p})^2}\right)^{-1}}$$

where summations extend over the range i = 1 to 1 = N-p. The power density with a discrete set $x_i(t)$ was given by

$$Lp = W_0 = 2 \sum_{q=1}^{M-1} W_q \cos \frac{qp\pi}{M} + W_M \cos p\pi$$

which deals with a spectrum involving angular frequencies no greater than π, M is the maximum value of the lag p, and $W_0, W_1, \ldots, W_M$ are autocovariance values.

TITLE: Orbit Determination and Ephemeris Computation
AUTHOR: Minka, K.

INITIATOR: Cronin, E. (SUYA)
PROJECT: 0001 PROBLEM NO. 1011

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV, MAP
MINIMUM CORE SIZE: 77_8k

Precise orbit determination and analysis of an orbiting vehicle was accomplished by a sequential filtering technique known as the Minimum Variance Method. The method was general in nature, because the effect of the constants on a particular arc of the orbit is determined by a state transition matrix which is obtained by a perturbation method. Thus, the analytical relationships between the orbital elements and the constants are not required. However, the method requires an initial estimate of the errors in the orbital elements and constants.

The accuracy of the position data is directly dependent upon the quantity, quality and distribution of satellite observations.

Not available for distribution until operating instructions are completed.

TITLE: Ray Tracing through Atmospheric Refraction
AUTHOR: Pustaver, J.

INITIATOR: Gast, P. (OPA)
PROJECT: 7670 PROBLEM NO. 1012

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 35_8k

This effort involves the computation of the refraction of a beam of light utilizing a ray tracing technique while making the following assumptions: (1) the earth is spherical; (2) the atmosphere behaves as a perfect gas; (3) the atmosphere is stratified with constant temperature gradient strata. It is capable of computing:

(1) pressure, density and temperature of the atmosphere
(2) index of refraction at any point
(3) a quantity PHI (ϕ) by integrating over the change in central angle Z(new) = Z(old) + PHI-REFRACTION
(4) optical mass.

TITLE: Atmospheric Analysis
AUTHOR: Forni, A.

INITIATOR: Gast, P. (OPA)
PROJECT: 7670 PROBLEM NO. 1013

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 34_8k

Atmospheric analysis, designed to calculate temperature, pressure and density for a specified altitude range with a given altitude increment, was performed. The data utilized consisted of temperature lapse rates at various altitudes for specified temperatures and pressures at sea level. The integral of density was found by the trapezoidal method.

TITLE: Multivariate Analysis and Correlation Coefficients
AUTHOR: Whelan, L.

INITIATOR: Rooney, T. (LWW)
PROJECT: 8623 PROBLEM NO. 1014

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 24_8k

An IBM System subroutine, REGRE, which performs a standard regression analysis, was modified to accommodate the specific input data. This input was a set of 24 geophysical data points, each with two independent and one dependent variables. Output included the following:

a. For each independent variable: mean, standard deviation, correlation, regression coefficient, standard error of regression coefficient and computed T value.
b. For each dependent variable: mean and standard deviation.
c. Intercept
d. Multiple Correlation
e. Standard Error of Estimate
f. Analysis of Variance
g. Table of Residuals.

TITLE: OV1-15 MS Data Processing
AUTHOR: Conway, E.

INITIATOR: Philbrick, C. (LKD)
PROJECT: 6687 PROBLEM NO. 101

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 77_8k

OV1-15 mass spectrometer (MS) data is read from tape, and the applicable masses and the height at the reading are retrieved.

When the tape has been completely searched and the masses properly classified as to type and as to whether they occur before or after perigee, the mass values of other elements are interpolated for the heights at which mass 16 (oxygen) observations occurred. The procedure is to pick out the three closest altitudes to the given one for each oxygen reading altitude and then use LaGrangian interpolation to get a predicted value at that height. If the predicted value is negative, it is recalculated using linear interpolation; if it is still negative, it is set equal to the previous value.

The percentages of the various atmospheric masses at the specified heights are calculated and plotted out vs the log of the altitude. The plots contain other information of interest, such as run data and perigee information.

TITLE: Aerodynamic Drag F
AUTHOR: Dabcovich, M.

INITIATOR: Glass, M. (LYC)
PROJECT: 8620 PROBLEM NO. 1016

HARDWARE/SOFTWARE: IBM 7044/Fortran II
MINIMUM CORE SIZE: 65_8k

Vertical displacement velocities of a wing subject to gusts of different frequencies were computed, using Laplace transforms to solve the differential equation modeling this initial value problem. For several values of the parameters; μ (wing constant), λ (gust frequency), and T (time interval), vertical displacement velocities were computed and plotted against time. Computation of accelerations and their plotting vs time is a program option.

TITLE: Spectrometer Studies
AUTHOR: Grossman, P.

INITIATOR: Hernandez, G. (LIR)
PROJECT: 7661 PROBLEM NO. 1017

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 65_8k

A ready means was provided for visual smoothing of experimental data from a concurrent Convolution-Fabry-Perot Photo-Electric study. The result was plotted output on a graph running from 0 to 1000 up to 300,000, depending on the scaling factor used. Input was from several data sets, each given a name and preceded by a header card.

TITLE: Statistical Analysis of Wind Data
AUTHOR: Forni, A.

INITIATOR: Noel, T. (LYC)
PROJECT: 5633 PROBLEM NO. 1018

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 77_8k

Linear correlations of wind data were computed at equally spaced height intervals, where the input data was initially linearly interpolated and vertically smoothed. It was necessary to account for the possibility of overlapping subsamples of the input data sample. Then, an empirical function was fitted to the data by the least-squares method. The fitted function was subtracted from the input data and auto and cross-correlations were computed using the differences as the variate.

TITLE: Model Development for Investigation of Turbulence
AUTHOR: Martine, J.

INITIATOR: Berkofsky, L. (LYD)
PROJECT: 8604 PROBLEM NO. 1019

HARDWARE/SOFTWARE: IBM 7030/Fortran
MINIMUM CORE SIZE: 110_8k

This problem studied the propagation of turbulence; that is, convection studies in the atmosphere very close to the earth's surface. The approach of the investigation was as follows:

A volume of space was partitioned into a number of horizontal layers. The equations of interest defined, at each layer, time rates of change for 5 functions—U, V, W directional velocity components, ρ pressure and χ the density. Then at each layer, it was necessary to compute

$$\frac{du}{dt}, \frac{dv}{dt}, \frac{dw}{dt}, \frac{dP}{dt} \text{ and } \frac{d\rho}{dt}$$

in order to propagate (in time) the variables which are functions of both space and time. Top boundary and initial value conditions were variable.

To compute the derivatives, the appropriate quantities must exist for five consecutive layers, except for the first and second levels (counting from the earth's surface), where the computation is somewhat different. Hence, if we need dw/dt at level s, then w values must be present for levels s+2, s+1, s, s-1, s-2.

TITLE: Crystal Growth for Physical Chemistry Study
AUTHOR: Persakis, T.

INITIATOR: Kennedy, J. (LQP)
PROJECT: 5621 PROBLEM NO. 1020

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 32_8k

This work effort was done with regard to a theory and computation developed by Parke Mathematical Laboratories to analyze solute distribution in a continuous zone-refining apparatus. The number of heater passes required to reach a steady state in both the enriching and stripping sections was determined for a variety of physical changes in the dimensions of the apparatus. The mathematical treatment of steady-state solute distribution in the stripping section (change in density due to melting) of the zone-void and matter transport systems described a section wherein the last zone freezes by the normal freeze method. A normal freeze of the last zone of the stripping section produces a maximum value of solute concentration.

TITLE: Atmospheric Variability Study
AUTHOR: Kellaher, J.

INITIATOR: Nee, P. (LKI)
PROJECT: 8624 PROBLEM NO. 1021

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 31_8k

The objective of this assignment was to compute the root mean square changes in temperature for several time and space intervals at 2000 ft and every 1000 ft above that level in order to further a meteorological problem concerned with atmospheric variability. Input data was on a tape and included the metro station, date and release time for each sounding. This sounding data was corrected and then used as input to obtain atmospheric variability tables based on 15-minute class intervals and 5-nautical-mile class interv ls.

TITLE: Chemical Crystal Studies
AUTHOR: Gerbes, I.

INITIATOR: Yannoni, N. (PHE)
PROJECT: 8659 PROBLEM NO. 1022

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 53_8k

This program is a modification of a program written originally by Paul Simpson, Harvard University, on chemical studies. At that time it was designed to run on an IBM 7090, and the source language was Fortran II. This job effort converted the program to run on the IBM 7044 computer. This program was concerned with X-ray data processing, particularly, the treatment of raw intensities of individual crystal levels. Precession and Weissenberg films were processed. Film factors and standard errors were calculated and applied. Plots and "Precession photographs" were output.

TITLE Absorption Studies Using Riometer Data
AUTHOR: Gerbes. I.

INITIATOR: Horowitz, S. (LII)
PROJECT: 5631 PROBLEM NO. 1023

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 43_8k

Riometer readings of amplitude taken at equal time intervals (universal time) were used to generate points for a scatter plot (sidereal time vs decibels), which was then used to determine a "quiet day curve" of activity in the upper atmosphere.

The purpose was to compare observed quiet days with computed quiet days in connection with a total absorption phenomenon study.

TITLE: Interpolation, Smoothing and Correlation
AUTHOR: Forni, A.

INITIATOR: Noel, T./MacLeod, M. (LYC)
PROJECT: 5633 PROBLEM NO. 1024

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 73_8k

This work effort resulted in a generalized interpolation, smoothing and correlation program where the data arrays could be variable in quantity and size and scale conversion subroutines could be called in variable order. The program also provides facilities to punch out an array and to delete an array from storage. For improved operation, a system routine was written and added to the library separately, entitled "RWB," which is a modification of the existing system "Read-Write Decimal" routine.

TITLE: Rocket Trajectory Calculation
AUTHOR: Hussey, L.

INITIATOR: Almasian, R. (LKB)
PROJECT: 6690 PROBLEM NO. 1025

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 24_8k

This program was designed to calculate rocket trajectory information, such as acceleration due to gravity, vertical and horizontal velocities using the following data inputs: apogee values, time in seconds, altitude velocity, horizontal velocity and drag coefficients. The equation used for computation due to gravity is:

$$G = A - BZ + CZ^2$$

where A, B and C are values read from input.

TITLE: PCM Telemetry Data Processing
AUTHOR: Truesdale, A.

INITIATOR: McInerney, R. (SUYA)
PROJECT: 0001 PROBLEM NO. 1026

HARDWARE/SOFTWARE: IBM 7094 II - 7044 DCS/Fortran IV, MAP
MINIMUM CORE SIZE: 50_8k

This program system unpacked, listed and/or plotted PCM telemetry data from a preprocessed magnetic tape to facilitate analysis. PCM telemetry messages were unpacked and the readings from the six sensors were corrected for vehicle aspect angle and mechanical backlash in the scanner. The results were listed and/or plotted on a scan-by-scan basis for any selected period of time. A number of special subroutines were written to enable the data to be processed. These included an unpacking routine to extract and reposition a specific group of contiguous bits from the IBM 36-bit word; an integer conversion routine for BCD digits to binary form; a leading zeros suppression routine; and a tape BCD-format to storage BDC-format conversion routine.

TITLE: Modification of Newton's Method
AUTHOR: Mazzio, V.

INITIATOR: Tsipouras, P. (SUYA)
PROJECT: 0001 PROBLEM NO. 1027

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 25_8k

The solution of a set of nonlinear simultaneous equations arises frequently in solving practical problems in physics and engineering. The equations can be expressed as the simultaneous zeroing of a set of functions, where the number of functions to be zeroed is equal to the number of independent variables.

During any iterative process, the bulk of the computing time is taken up by performing function evaluations. The computer program "SIMNONL" utilizes a method suggested by C.G. Broyden in "A Class of Methods for Solving Nonlinear Simultaneous Equations" (J. Math. Comp., Vol. 13, pp. 557, 1965) to reduce the number of function evaluations.

This method, a modification of the well known Newton's Method, required that estimated values of the unknown variables be supplied in order to allow the iterative process to converge to a physically significant solution.

The iterative results were printed out.

TITLE: Tape Copy Utility Routines (IBM 1460)
AUTHOR: Hussey, I.

INITIATOR: Cronin, E. (SUYA)
PROJECT: 0001 PROBLEM NO. 1028

HARDWARE/SOFTWARE: IBM 7044; IBM 1460/Fortran IV, MAP
MINIMUM CORE SIZE: 22_8k

The purpose of this work effort was to write a tape copy routine to process a binary input tape in either of two ways. On the IBM 1460, the program copies a binary tape creating a new tape where the first six characters of each record have been eliminated. Records should be less than or equal to 7000 characters (that is, about 1300 words). When the "END OF REEL" is encountered, an end-of-file is written and a new tape is requested. On the IBM 7044, a binary tape is copied, omitting the first word of each record. Maximum size is 20,000 words. The same procedure occurs for an END-OF-REEL.

TITLE: Computation of Look Angles
AUTHOR: Hussey, I.

INITIATOR: Hussey, I. (SUYA)
PROJECT: 0001 PROBLEM NO. 1029

HARDWARE/SOFTWARE: IBM 7044/Fortran IV, MAP
MINIMUM CORE SIZE: 77_8k

Given a set of elements and their derivatives at a certain epoch, "look angles" can be computed as a function of time for any given number of stations.

The input data and ephemeris information are printed. This ephemeris data includes time, elevation angle, elevation rate, azimuth, azimuth rate, range velocity, right ascension, declination, sub-satellite latitude and longitude, sun elevation, satellite illumination angle, revolution number and camera roll angle. In addition, a binary tape of satellite information and station observation data can be produced.

TITLE: Atomic Spectra Research – Theoretical Studies
AUTHOR: Grossbard, N.

INITIATOR: Mapleton, R. (LKS)
PROJECT: 8627 PROBLEM NO. 1030

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 47_8k

As an aid to Atomic Spectra Research, three programs were developed as a system attempt to find the cross-section for electron capture from heavy atoms by protons, CRT-plotting the data as a presentation aid. Also two sets of values of integrands were plot-compared to allow the investigator to see how additional values of the integrand changed the description of the curve. Evaluation of nitrogen, oxygen, neon and argon molecules was accomplished. The cross-section calculation varied with energy and with the particular element being investigated.

TITLE: Atmospheric Model Study
AUTHOR: Gerbes, I.

INITIATOR: Marcos, F. (LKB)
PROJECT: 6690 PROBLEM NO. 1031

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 77_8k

An atmospheric model was structured using density and temperature analysis. The program was written in a generalized form: for instance, it was possible to read a set of "standard" densities not necessarily in $\log_{10}$ form, nor in 10 km intervals. Densities were used as read or related mathematically to new densities. If necessary, interpolation to get values in any altitude measurement was possible. From these values, new densities related by a mathematical expression were derived and punched onto cards. Temperature analysis used density cards which had been incorporated into a "data deck," using backward interpolation in altitude to give temperature vs altitude in intervals; for example, 10 km, 5 km. Summer and winter data analysis was performed.

TITLE: OV1-15 Neutral Correction
AUTHOR: Atkinson, J.

INITIATOR: Philbrick, C. (LKD)
PROJECT: 6687 PROBLEM NO. 1032

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 55_8k

The basic purpose is to correct the recorded values of current from satellite OV1-15.

At a certain magnitude, the graph of the current for any particular sweep levels off. It was desired to extend the curve in this range to give the shape a more parabolic appearance. This task was accomplished by means of various interpolation, smoothing and curve-fitting routines.

Also, the program can compute the lowest interpolated value for the emission regulator monitor (ERM) at perigee, and from this, develop tne minimum ERM for each sweep dependent on the altitude of the sweep.

The input tapes are DCS-formatted tapes, so that in order to run on the CDC 6600, they have to be preprocessed to convert them to CDC 6600 format.

TITLE: Rapid Orbit Determination
AUTHOR: Robinson, E.

INITIATOR: Marcos, F. (LKB)
PROJECT: 6690 PROBLEM NO. 1033

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 41_8k

The Rapid Orbit Prediction Program (ROPP) performs very rapid computation of orbital elements over many revolutions. The mean rates of change of Keplerian elements are numerically integrated to a specified time. Atmospheric drag effects and the gravitational potential of the earth are taken into consideration.

"ROPP" can predict the mean orbital elements over long intervals of time for satellite lifetime predictions. It can also be used to predict look angles for planning purposes, and eclipse times can be generated.

An eighth-order Adams Moulton integrator is used to predict the satellite parameters. Perturbations considered by the program consist of drag, luni-solar effects, earth oblateness and terms from the geopotential.

It was used in prelaunch studies for satellites OV1-16, OV1-15, OV3-6, OV1-17, OV1-17A, OV3-2, OAR 901 and OAR 907.

TITLE:	Raw Telemetry Data Plot
AUTHOR:	Delorey, D.
INITIATOR:	McInerney, R. (SUYA)
PROJECT:	0001 PROBLEM NO. 1034
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	65_8k

The reduction and analysis of rocket experiment data frequently requires a plot of the raw telemetry voltage values as a function of time.

The raw data values, thus exhibited, give an immediate indication of the quality of the rocket data to the analyst. Possible trouble spots in the data of any rocket experiment can be seen easily, and the computer program to reduce the data can be written accordingly.

TITLE:	Plot of Ionospheric Parameters
AUTHOR:	Conway, E.
INITIATOR:	Toman, K. (LII)
PROJECT:	5631 PROBLEM NO. 1035
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	65_8k

The values for ionospheric parameters F_0F_2 and F_0E (averages for Washington, D.C.) are read from magnetic tape supplied by the initiator. These parameters are printed and plotted on a yearly basis (years 1946 to 1984), each on the same plot.

TITLE:	Transmission and Reflection Analysis	
AUTHOR:	Grossbard, N.	
INITIATOR:	Lowenstein, E. (OPI)	
PROJECT:	7670	PROBLEM NO. 1036
HARDWARE/SOFTWARE:	IBM 7044/Fortran IV	
MINIMUM CORE SIZE:	77_8k	

Given absorption vs frequency and reflection vs frequency data, the coefficient of absorption and the index of refraction were found for several thicknesses of milar. Mathematical analysis to form a graph of frequency vs absorption was done where absorption solution was found by dividing "energy" including absorption by the "energy" vs "path length." "Energy" of a particular frequency is equal to its Fourier coefficient as calculated from the data.

The two sets of data corresponded to two runs of the same experiment. In one, there was no absorber and in the other, there was an absorber. It was assumed that the equipment was stable and measured a quantity proportional to the actual energy. In computing absorption, the method was considered as being equivalent to measuring the "energy," which implied multiplying both numerator and denominator of the "energy" fraction by a constant.

Fourier coefficients were calculated by two developed mathematical techniques which resulted in more accurate coefficients than a traditional Fourier analysis. One technique was applied because all of the sinusoidal functions which lead to the Fourier coefficients were at a maximum at one point in the data. If the maximum was chosen at the origin, only cosine terms appeared in the Fourier expansion. This cosine series had a symmetrical property which was expected from the experiment. In actual practice, the most accurate data occurred near the maximum, and this limited amount of data (approx. 41 pts) was used to employ the second technique known as apodization, which was used to remove the discontinuities arising from the finite length of the sample. Convolution determination, a calculation of the first technique, gave two results: (1) the use of a limited set of convolution values lead to transformed data, which had been filtered for only the calculated values; (2) transformed data had fewer points than the original data by the number of values used in taking the convolution.

Related work was performed under Problem Nos. 1037 and 1042.

TITLE: Fourier Spectrum
AUTHOR: Grossbard, N.

INITIATOR: Lowenstein, E. (OPI)
PROJECT: 7670 PROBLEM NO. 1037

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 77_8k

In conjunction with the analysis done in Problem No. 1036, additional programming prepared the data used as input. Programming involved the division of the Fourier spectrum of two sets of data and calculation of the Fourier transform. To improve the Fourier transform results, use was made of phase information that was available in the data. The two groups of data were analyzed for their Fourier coefficients over a given range and increment. The Fourier coefficients of the first group were then divided by the corresponding Fourier coefficients of the second group. The resulting numbers and their associated frequencies were then printed and punched.

TITLE: Molecular Field Coefficients in Ferrimagnets
AUTHOR: Grossbard, N.

INITIATOR: Gianino, P. (LQR)
PROJECT: 5621 PROBLEM NO. 1038

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 77_8k

It was demonstrated that instead of yielding unique values of α and β for yttrium iron garnet (YIG) and lithium ferrite, the analytic method of calculating molecular field coefficients in ferrimagnets yields only one of many possible (α, β) pairs from a linearly related set. The magnitudes of the internal magnetic fields, total magnetic moment, and the two sublattice magnetic moments, computed from any of the possible coefficients, remain relatively unchanged even though (α, β) and n are extremely sensitive to the input parameters and number of experimental data points. From within the framework of the theory itself, it was shown how it was possible for the manifold of (α, β) pairs to exist in a linearly related manner and how an analytic expression for this dependency could be derived, utilizing low temperature information. A procedure for testing whether the coefficients for other ferrimagnets could be uniquely determined was researched. "Best" values of (α, β) were obtained by minimizing a least-squares percentage error. These values not only fell along a straight line, but also were in agreement with those generated in the usual application of the analytical method. The use of the "linearity" test in the x-y graph as a criterion for judging the appropriateness of the selected value of the Curie point was shown to be invalid. Studies at various magnetic moments and internal fields under varying input conditions were done for both YIG and lithium ferrite. A sophisticated iteration technique was used to find the best constant values which were needed to fit the data.

TITLE:	Wave Functions Analysis	
AUTHOR:	Grossbard, N.	
INITIATOR:	Jursa, A. (PH)	
PROJECT:	8627	PROBLEM NO. 1039
HARDWARE/SOFTWARE:	IBM 7044/Fortran IV	
MINIMUM CORE SIZE:	77_8k	

The Rydberg-Klein-Rees (RKR) method is a semi-classical procedure for determining the potential curve of bound-states of diatomic molecules by obtaining the turning points of the motion from the measured vibrational and rotational levels. Potential energy curves were calculated from band spectra data to find eigenfunctions of diatomic molecules using the RKR method. An attempt was made to modify a program written at the University of Maryland for William Benesch called "Numerov-Franck-Condon" to increase its accuracy with the data available. The program fitted data to a curve so that by using an energy vs radius function defined in terms of the fitted curves, an attempt could be made to find the numerical solution of Sherdinger's differential equation. Important changes in modification included prevention of round-off errors, exponential overflow and exponential underflow; and interpolation of the data instead of a fitting curve. It was found that the theory did not lead to a consistent answer since interpolation of data for a derivative was extremely dependent on the particular method used. Results were questionable and research was discontinued.

TITLE:	Rocket Flare Triangulation	
AUTHOR:	Grossbard, N.	
INITIATOR:	Dishong, P. (LWG)	
PROJECT:	7600	PROBLEM NO. 1040
HARDWARE/SOFTWARE:	IBM 7044/Fortran IV	
MINIMUM CORE SIZE:	51_8k	

The positions of various ground stations are determined from the positions at which they simultaneously see a satellite. It was necessary to convert this program to the IBM 7044 in order to use it for geodetic positioning analysis from simultaneous optical observations of the ANNA 1-B Satellite. The following features were included:

a. Observations of flare points were given in the form of direction cosines, camera plate coordinates or right ascensions and declinations.

b. Observational-error signals were supplied on each observation card, or a sigma was given on each station card to be used on all observations from that station.

c. A camera and range station located very close to each other were treated as a single "dual" station.

d. The maximum number of range stations, flare points, etc., that could be handled were determined by the availability of core storage. The method by which the program generated its output was the method of "maximum likelihood."

TITLE: Geological Study of Faults
AUTHOR: Russell, J.

INITIATOR: Eastler, T. (LWH)
PROJECT: 7628 PROBLEM NO. 1041

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran ."
MINIMUM CORE SIZE: 31_8k

Several functions of a set of data points that discretely describe the magnitude of the wave formation created by a seismological disturbance were evaluated for geological studies and the investigation of faults involved in wave formation.

Each data group represented the waveform between given seismological faults. The Fourier coefficients and power spectra for each group were printed, and plots of the power spectrum vs frequency were produced.

TITLE: Fourier Spectrum
AUTHOR: Grossbard, N.

INITIATOR: Loewenstein, E. (OPI)
PROJECT: 7670 PROBLEM NO. 1042

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 77_8k

Previous analysis started under Problem Nos. 1036 and 1037 was continued, utilizing an additional mathematical technique to calculate the Fourier coefficients rapidly. The mathematical technique used involved extrapolating a Fourier coefficient from a surrounding group of calculated Fourier coefficients. This extrapolation gave accurate-enough answers if the calculated Fourier coefficients had the following properties:

a. The calculated Fourier coefficients were equally spaced in the frequency domain and were "close enough" together.

b. At least 20 Fourier coefficients for frequencies higher and lower than the frequency for which the extrapolation would occur were available.

The general extrapolation formula is

$$\sum_{k=-19}^{20} f\,[(n+\ell)\,\Delta w]\ \frac{\sin\,[(2\pi/\Delta w)\,(\delta w-n\,\Delta w)]}{(2\pi/\Delta w)\,(\delta w-n\,\Delta w)}$$

where w is the frequency desired, Δw is the spacing, in frequency space of the values of the Fourier coefficients, f, determined by some other method, ℓ is an integer such that $\ell\Delta w < w < (\ell+1)\Delta w$, and $\delta = w-\ell\Delta w$. This expansion is accurate where f is a "slowly" varying function. This method of calculation is often faster than any comparable method.

TITLE:	Spectral Analysis	
AUTHOR:	Grossbard, N.	
INITIATOR:	Rush, C. (LII)	
PROJECT:	000D	PROBLEM NO. 1043
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV, MAP	
MINIMUM CORE SIZE:	71_8k	

This problem used an existing power cross spectrum program, developed under Problem No. 1044, and further developed analysis as specified by the initiator. As before, the problem involved finding the phase and coherence of the cross-correlation function.

Research involved the following:

a. An attempt to analyze how, for a particular frequency, the amplitude and phase, respectively, behaved vs time.
b. Special numerical filter analysis, using one or two sets of data and deriving Fourier power coefficients, cross-spectra, coherency and phase values.
c. Derivation of Fourier power coefficients from one set of data after applying a different band pass numerical filter.

TITLE:	Spectral Analysis	
AUTHOR:	Grossbard, N.	
INITIATOR:	Rush, C. (LII)	
PROJECT:	5631	PROBLEM NO. 1044
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV, MAP	
MINIMUM CORE SIZE:	70_8k	

The phase and coherence of the cross-correlation function of two sets of spectral data were found. In setting up the data, the following mathematics were used:

a. Let $x(t)$ be a set of data with missing points at $x(t_k)$, $x(t_\ell)$..., etc. The problem was to interpolate data values for the missing points. To accomplish the interpolation, place zero in all the missing data points, calling this data $y(t)$.

b. Let $z(f) = F[y(t)]$ where F stands for Fourier transforms. Then find $w(t) = F(|z(f)|^2)$. Next, consider $x(t)$ and a missing data point $x(t_k)$ determining the interpolation value,

$$x^1(t_k) = \frac{\sum_{\text{set } s} x_1(t_{k+n}\Delta)\, w(\ell n \Delta 1)}{\sum_{\text{set } s} w(\ell n \Delta 1}$$

Where Δ was the time spacing, s was the intersection of $|n| \leq 100$, and $w(\ell n \Delta 1) > 0$, and $x_1(t_{k+n}\Delta)$ is not a missing data point or off the ends of the data. Programming analysis included calculation of auto- and cross-correlation power spectra functions, phase values and coherency in addition to the Fourier power vs frequency values for the CRT plots.

TITLE: Quantum Mechanics
AUTHOR: Tsipouras, P.

INITIATOR: Jasperse, J. (LQR)
PROJECT: 5621 PROBLEM NO. 1045

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 50_8k

This problem was concerned with a problem in quantum mechanics, which was divided into many parts. For each of these parts (A, B, D, C, AN), a separate program was written to calculate or solve designated functions or equations. Each of these sections dealt with a particular set of relationships between the particles.

Part A was concerned with particles of some mass and δ-function potential between each pair. Part B consisted of three programs and considered K-S curves for three particles of different masses and different potentials S1, S2. Part D consisted of four programs, each dealing with three identical particles, together designed to calculate eigenfunction, energy of system, wave function (Hilbert Space), and analytic properties examined. Part C dealt with the ground state of Helium atom and some excited energy states. Finally, AN will calculate analytic solution of the energy and wave function.

TITLE: Determination of Solar Temperature Distributions
AUTHOR: Atkinson, J.

INITIATOR: Kalaghan, P. (LZN)
PROJECT: 8682 PROBLEM NO. 1046

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 31_8k

The object of this program is the determination of solar temperature distributions from a 19-by-19 point raster scan of the solar disc at a wavelength of eight mm. In particular, one wants a 19-by-19 array of temperatures formed by taking the difference of a particular day's array and a mean array characteristic of the quiet sun. In this way, a mapping of the deviation of the temperature of the sun from its quiescent levels may be obtained. A Gaussian smoothing technique is used with a special exponential equation used on trouble spots, that is, perimeter points with the greatest deviations.

TITLE: Quiet v Absorption Studies
AUTHOR: Gerbes, .'

INITIATOR: Horowitz, S. (LII)
PROJECT: 5631 PROBLEM NO. 1047

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 77_8k

- monthly diurnal (daily) variation of absorption was determined from riometer lings of amplitude gathered by various stations at equal time intervals over a 's period.

.et day" or reference curve for a particular station was supplied, where the consisted of 120 points when the corresponding sidereal time was assumed .o range from 00:00 to 23:98 in 0.2 intervals. Punched input cards containing decibels by universal time were compared with the reference curve in order to determine the average absorption for each hour.

TITLE: Elastic Wave Radiation
AUTHOR: Grossbard, N.

INITIATOR: Haskell, N. (LW)
PROJECT: 7639 PROBLEM NO. 1048

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 23_8k

Calculations were performed to determine the total energy and energy spectral density of elastic wave radiation from propagating faults. The program was written at Columbia University and was modified to run at AFCRL on the IBM 7044.

Assuming that the fault break propagat- in one direction along the long axis of the fault plane and that the relative displacement at a given point has the form of a ramp time function of finite duration "T," the total "P" and "S" wave energies and the total energy spectral densities are evaluated in closed form in terms of the fault plane dimensions, final fault displacement, the time constant "T," and the fault propagation velocity.

TITLE:	Plots for Conic Residuals	
AUTHOR:	Persakis, T.	
INITIATOR:	Hadgigeorge, G. (LWG)	
PROJECT:	7600	PROBLEM NO. 1049
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	60_8k	

Two programs are included in this problem number.

"GEOPRO" satisfies a request to modify a program which makes corrections to data for polar motion, parallactic refraction, time corrections and phase angle. The program also converts geoceiver observations to range differences corrected for ionospheric refraction.

The changes are as follows:

a. To permit the program to edit up to 171 orbits of geodetic satellite data.
b. To compute the residuals of data fitted to a series of polynomials and conics.
c. To print out the residuals of each flash sequence in microns.
d. To plot on linear scale the conic residuals vs time (in seconds) of each flash.

"GERR01" calculates and prints out the azimuth and elevation for a given topocentric right ascension and declination given the following: (1) Greenwich hour angle, (2) time in seconds from zero hours GMT (Greenwich Mean Time), (3) station latitude, (4) station longitude (positive west). All quantities in radians.

TITLE:	Spectral Analysis of Sunspot Numbers	
AUTHOR:	Grossbard, N.	
INITIATOR:	Toman, K. (LII)	
PROJECT:	5631	PROBLEM NO. 1050
HARDWARE/SOFTWARE:	IBM 7044/Fortran IV	
MINIMUM CORE SIZE:	74_8k	

The Fourier spectrum of data representing flux through the atmosphere is analyzed. The power spectrum is found by simply finding the coefficients of the sine, cosine expansion of data. The program prints the square root of the sum of the squares of the coefficients of the sine, cosine series for a particular frequency. The results are then graphed linearly and logarithmically.

TITLE: Geodetic Positioning Utilizing Optical Observations
AUTHOR: Grossbard, N.

INITIATOR: Dishong, P. (LWG)
PROJECT: 7600 PROBLEM NO. 1051

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/ Fortran IV
MINIMUM CORE SIZE: 77_8k

The "Intervisible" program, which was written under Problem No. 1040 for the IBM 7044, was modified so that it could be run on the IBM 7094 II-7044 DCS.

Given were nominal locations of a set of observation stations, observed values of unit vectors from certain of these stations to a number of "flare points," observed values of the range from certain of these stations to a number of "range points," standard deviations for all measurement errors, station errors and errors in the speed of light, and a nominal speed of light.

Output consisted of (1) corrected locations of the observation stations, (2) locations of all flare points, (3) locations of all range points, (4) suggested shifts in all datums, (5) a corrected value of the speed of light, (6) calculated values of the bias in range observations and (7) standard deviations for the errors in the above outputs.

TITLE: Spectral Distribution of Sinusoidal Wavelet
AUTHOR: Gerbes, I.

INITIATOR: Toman, K. (LII)
PROJECT: 5631 PROBLEM NO. 1052

HARDWARE/SOFTWARE: IBM 7044/ Fortran IV
MINIMUM CORE SIZE: 43_8k

Spectral distribution of sinusoidal wavelets was computed and plotted as part of a study of the upper atmosphere.

Line plots of frequency vs power were produced on the Calcomp plotter. Maximum power and corresponding frequency were determined for each given increment, and maximum power and frequency were plotted vs ϕ (angle in degrees) as a scatter plot for each ϕ.

TITLE:	Density and Temperature Analysis	
AUTHOR:	Bacon, D.	
INITIATOR:	Marcos, F. (LKB)	
PROJECT:	6690	PROBLEM NO. 1053
HARDWARE/SOFTWARE:	IBM 7044/Fortran IV	
MINIMUM CORE SIZE:	3_8k	

Tabular values of densities and a new set of temperatures for specified altitudes were computed.

Four sets of number density vs altitude data in 10-km intervals from 120-km to a variable upper limit of between 180 to 270 km were input for each case.

A set of punched cards consisting of identification information and computed temperatures at various altitudes were output.

TITLE:	Hobb's Encoder - Decoder Communication System Analysis	
AUTHOR:	Mandell, C.	
INITIATOR:	Brazy, J. (LRD)	
PROJECT:	4610	PROBLEM NO. 1054
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	25_8k	

The purpose of this problem is to analyze the potential capabilities of the Hobb's Encoder-Decoder Communication System over a simulated communication channel.

In order to evaluate experimentally Hobbs' dynamic threshold technique of failsafe decoding and error correction, transmit/decode-error data and accept/reject-word data are processed by "HEDCOM." The data, which was collected serially on a one-track PI 2000 incremental-digital tape recorder, is the input to this IBM 7094 II-7044 DCS program. The processed data is printed out in the form of tables, arrays, and various statistical parameter values, which facilitate the determination of transmission and decoding error tallies and statistical control on each channel noise condition being simulated.

TITLE: Ionospheric Non- Derivative Absorption
AUTHOR: Grossman, P.

INITIATOR: Sales, G. (LII)
PROJECT: 5631 PROBLEM NO. 1055

HARDWARE/SOFTWARE: IBM 7044/ Fortran IV
MINIMUM CORE SIZE: 35_8k

Non-derivative absorption in the upper atmosphere is a function of the electron density, collision frequency, angular radio frequency, angular electron gyrcfrequency and the altitude.

A program was written to compute the absorption (both ordinary and extraordinary) of each specified altitude step and to obtain the integrated ordinary and extraordinary absorption over the entire range. Simpson's Rule was used for the integration.

TITLE: Wind Velocity Data Reduction
AUTHOR: Grossbard, N.

INITIATOR: Barnes, A. (LYU)
PROJECT: 8628 PROBLEM NO. 1056

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS; CDC 6600/Fortran IV, MAP
MINIMUM CORE SIZE: 130_8k

A series of programs was written to reduce wind velocity data. Solar, lunar and sidereal periods were separated from radar meteor trail wind data and tested for significance.

A two-dimensional auto-correlation function (height and time) was obtained for the purpose of interpolating and smoothing the data for ultimate use in two-dimensional spectral analysis.

Two approaches were taken in the study of moving synoptic, weather systems. The first method was to remove the high frequencies (one day or less) and look at the remainder. The second method was to remove the significant periods (frequencies) separated previously.

Specifically, programs were written to follow the amplitude or phase of any particular frequency vs time. Also, the variations of phase and amplitude of frequencies could be found by using a root-mean-square technique.

TITLE:	Correction of Meteorite Trail Data
AUTHOR:	Grossman, P.
INITIATOR:	Barnes, A. (LYU)
PROJECT:	8628 PROBLEM NO. 1057
HARDWARE/SOFTWARE:	IBM 7044/Fortran IV
MINIMUM CORE SIZE:	22_8k

A program was written to correct meteorite trail data. A new deck of cards containing both the old values (with some of these corrected) and new calculated values was produced from a deck provided by the initiator.

The input cards contained date, time, identification information, range, decay slope, azimuth angle, elevation angle from film, elevation angle code, sign of doppler wind speed, doppler wind speed and height. The range was corrected and output on cards along with such parameters as computed elevation angle, horizontal wind and height. In addition, the corrected cards were listed.

TITLE:	Variation of Particle Density in the Atmosphere
AUTHOR:	Gerbes, I.
INITIATOR:	Sales, G. (LII)
PROJECT:	5631 PROBLEM NO. 1058
HARDWARE/SOFTWARE:	IBM 7044/Fortran IV
MINIMUM CORE SIZE:	77_8k

Two electron-ion rate equations were solved numerically in order to obtain the variation of electron density, negative ion density and positive ion density a functions of time at various altitudes in the atmosphere.

The two non-linear, ordinary differential equations of the first order and degree were solved by the Runge-Kutta-Gill method.

The program also provides for graphical outputs and for a check solution when necessary.

TITLE:	First-Pass A-D Tape Conversion	
AUTHOR:	Roehrig, H.	
INITIATOR:	Reed, J. (OPR)	
PROJECT:	4200	PROBLEM NO. 1059
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV, MAP	
MINIMUM CORE SIZE:	25_8k	

The on-site A-D converting equipment generates a digitized tape in a format not immediately usable by the DCS. A routine was originally developed to convert non-Fortran first-pass A-D output tapes to a more suitable format for IBM use. It was written to provide the user with the ability to choose, at execution, the input file and type of data in that file to be processed; the method of normalization best applicable to his data, and the type of output tape desired, either BCD for listing and plotting, Fortran-compatible binary for further computer usage, or both. This original program, "CVTCRL," Problem No. 1605, was modified to minimize the amount of punched card input required to process a non-standard A-D first-pass tape containing many files. This modified version, "CVTRL" allows one set of file options to apply to all data files being unpacked and processed.

TITLE:	Power Spectrum Analysis - Electron Fluxes	
AUTHOR:	Grossbard, N.	
INITIATOR:	Hegblom, R. (LIJ)	
PROJECT:	7663	PROBLEM NO. 1060
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV, MAP	
MINIMUM CORE SIZE:	47_8k	

A power spectrum of electron fluxes measured by an electrostatic analyzer flown on Astrobee Rocket 15.735 was required. The data for electron fluxes

$$\int_{2.7\ \text{kev}}^{3.3\ \text{kev}} N(E)dE \quad \text{and} \quad \int_{2\ \text{kev}}^{8\ \text{kev}} E\,N(E)dE$$

as a function of time was on tapes at Boston College. The data points were separated by 0.3 seconds, and extend from 80 to 400 seconds after launch. There were about 10 sections containing 3 to 4 data points, which were omitted on the tape because of noise or incorrect analysis of the data. A plot of the power per unit frequency as a function of frequency was required.

Three programs satisfy this problem requirement.

"FOR CORR" interpolates the data points for time vs flux and energy found on the input tape for the purpose of finding equally spaced data points.

"CHECK DATA" prints energy and flux vs time data from the input tape.

"FINAL CORR" investigates the power vs frequency behavior of the data prepared by "FOR CORR" and found the data tape produced by "FOR CORR."

TITLE: Crystallographic Analysis
AUTHOR: Bacon, D.

INITIATOR: Euler, F. (LQO)
PROJECT: 5621 PROBLEM NO. 1061

HARDWARE/SOFTWARE: IBM 7090/Fortran IV, FAP
MINIMUM CORE SIZE: 77_8k

This program represents a least-squares procedure for refining crystallographic lattice constants, based upon observations obtained from films or diffractometers by single-crystal or powder techniques.

The program is capable of refining up to nine systematic correction parameters, such as, instrumental parameters for film shrinkage, specimen absorption, camera eccentricity, or x-ray beam divergence. Selection of systematic correction terms to be applied to each observation is based on input data provided by the user.

Least-squares refinement may be carried out through any number of iterations and is performed by using the full normal equations matrix. Observed and calculated values for interplanar spacings for each observation are printed before and after each iteration, and the least-squares adjustments to both the reciprocal and direct lattice constants, plus any systematic correction parameters are printed after each cycle. To facilitate computation of errors in interatomic distances, angles and other structural features, the program provides the direct lattice constant variance-covariance matrix as output after each cycle.

TITLE: Multivariate Response Surface Polynomial Fit
AUTHOR: Menegakis, D.

INITIATOR: Klick, D. (LWH)
PROJECT: 8623 PROBLEM NO. 1062

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 77_8k

The purpose of this program is to make operational a "Multivariate Response Surface Polynomial Fit" by computing polynomial coefficients to a set of data and by performing the statistical analyses for the regression.

The following polynomial coefficients of each degree to the one specified are computed:

a. The analysis of the variance summary
b. The standardized regression coefficients
c. The correlation coefficients
d. The confidence limits (.90, .95, .99 levels)
f. The comparison between original and computed dependent variable.

TITLE: Topside Extrapolated Profile for Ionospheric Studies
AUTHOR: Persakis, T.

INITIATOR: Pike, C. (LIB)
PROJECT: 5631 PROBLEM NO. 1063

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 45_8k

"INTER" does interpolation and plotting of ionospheric electron density profile vs time. The data is from four observation stations:

a. AFGB - Grand Bahamas
b. AFSF - San Francisco
c. AFWX - White Sands
d. AFAP - Air Plane

The data (consisting of days, hours, minutes and values for X) is separated into four sets of dates from which it is possible to produce 16 off-line plots and printouts of the calculated topside extrapolated N(h) profile Y.

TITLE: Wind Velocity Computations
AUTHOR: Dabcovich, M.

INITIATOR: Nee, P. (LKI)
PROBLEM: 8624 PROJECT NO. 1064

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 30_8k

The objective of this program is to compute the mean. standard deviation, and frequency distribution of the wind speed by component, month and station at several fixed altitudes in order to calculate and categorize wind speed velocities.

The data is contained on magnetic tape, and arranged by station and month. All soundings occur between 1900 and 0300Z. Each sounding consists of a set of card images containing altitude and wind velocity information. The program reads this data and produces a report of meridional and zonal wind velocities.

The output consists of 24 tables for each station. Each table represents the mean, standard deviation and frequency distribution of the zonal or meridional wind at a particular station during a particular month.

TITLE: Averaging Absorption Values
AUTHOR: Grossman, P.

INITIATOR: Horowitz, S. (LII)
PROJECT: 5631 PROBLEM NO. 1065

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 20_8k

A general subroutine was written to give the weighted averages of a set of absorption values calculated on a decibel scale.

Thirty-day (one set per day) absorption samples are averaged, and the average is weighted toward the sample occurring the most times. The calculations are performed by a grouping technique.

TITLE: Radio Frequency Evaluation
AUTHOR: Grossman, P.

INITIATOR: Straka, R. (LIR)
PROJECT: 4643 PROBLEM NO. 1066

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 77_8k

The frequency of fringe maximum [F(N)] as a function of lobe number (N), the solar declination (delta), and the time after meridian pass (T) are calculated.

The equation,

$$F_n = 1.11 \frac{n}{\cos \delta} \times \frac{1}{\sin \left(\frac{2\pi}{720}\right) t}$$

is solved as,

$\delta = 0, 1°, 2° \ldots 24°$

$n = 1, 2, \ldots 35$

$t = 10, 20, \ldots 240$

TITLE:	Rocket AJ17.758 Aspect Calculation	
AUTHOR:	Fioretti, P.	
INITIATOR:	Ulwick, J. (LIJ)	
PROJECT:	7663	PROBLEM NO. 1067
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV	
MINIMUM CORE SIZE:	40_8k	

"RASP" is part of an operating system to calculate rocket aspect from gyroscopic data transmitted during flight. The corrected pitch and gyroscopic data from rocket number AJ17.758 is input to "RASP," which calculates the azimuth, elevation, and angle of attack of the rocket aspect. Altitude and magnetic field data are calculated as a function of time and output with the angle of attack between the longitudinal axis of the rocket and the velocity and magnetic field vector.

TITLE:	Long-Wire Antennas in the L-F Range	
AUTHOR:	Korff, H.	
INITIATOR:	Ganio, A. (LII)	
PROJECT:	5631	PROBLEM NO. 1068
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	61_8k	

Program "GANIO" was written to calculate a set of generalized equations used in designing long-wire antennas in the L-F range. It enables calculation of the operating characteristics of the antenna–for example, impedance, bandwidth, efficiency, field strength–from the physical parameters of the array; that is, wire size, length, spacing, elevation, soil conductivity and frequency. The purpose of the computation is to estimate the electric field strength which would be produced at a point at a distance, by an antenna comprised of parallel wires at a length above the ground of conductivity. The antenna is fed by a generator of characteristic impedance, designed to deliver power to a matched load. The antenna is assumed to be centerfed, and the electric field strength is the summation of the field contributions of the individual wires. The program allows both the generator impedance and the terminal impedance to be set equal to the sum of the input impedances and the characteristic impedances for each wire.

The experiment was conducted at Quabbin Reservoir in Massachusetts, and involved low-frequency signals at vertical incident. In the initial phases, only four frequencies were used (3×10^4, 66×10^3, 180×10^3, 525×10^3 Hz). The receiving antenna was tuned to magnetic loops receiving two mutually perpendicular polarized waves for each frequency.

TITLE:	Rocket AJ17.906-1 Aspect Calculation	
AUTHOR:	Fioretti, P.	
INITIATOR:	Ulwick, J. (LIJ)	
PROJECT:	7663	PROBLEM NO. 1069
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV	
MINIMUM CORE SIZE:	40_8k	

"RASP" is part of an operating system to calculate rocket aspect from gyroscopic data transmitted during flight. The corrected pitch and gyroscopic data from rocket number AJ17.906-1 is input to "RASP," which calculates the azimuth, elevation and angle of attack of the rocket aspect. Altitude and magnetic field data are calculated as a function of time and output with the angle of attack between the longitudinal axis of the rocket and the velocity and magnetic field vector.

TITLE:	Grid Point Pressure Evaluation	
AUTHOR:	Carbone, J.	
INITIATOR:	Conover, J. (LYS)	
PROJECT:	6698	PROBLEM NO. 1070
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	70_8k	

The purpose of the program is to evaluate grid point pressures over a large area of Southeast Asia.

The completed portions of the program accomplished the following:

a. Extraction of data from 570 selected stations onto tape 1.

b. Conversion of alphanumeric quantities to integers, discarding unsuitable figures.

c. Preparation of a list of readings from 12 stations over three months for 1967 and 1968

Lack of data terminated the work.

TITLE:	Charged Particle Energy Loss – $\left(\frac{de}{dx}\right)$ Cosmic Ray Studies	
AUTHOR:	Grossbard, N.	
INITIATOR:	Kuck, G. (PHE)	
PROJECT:	8600	PROBLEM NO. 1071
HARDWARE/SOFTWARE:	IBM 7044/Fortran IV	
MINIMUM CORE SIZE:	21_8k	

The energy loss of almost any particle the size of a proton or larger is determined. The energy loss is calculated for a given initial energy which is due to a given thickness of a given material. In order to perform the calculations, a variation of a subroutine found in Rapid Computation of Specific Energy Losses for Energetic Charged Particles, issued by Oak Ridge National Laboratory by R.W. Peele, was used. This subroutine calculates an approximate derivative of energy loss per unit distance in the absorbing material for a given initial energy. A program was written which used this derivative as a constant for short traverses in the absorbing material to determine the energy loss. A self-checking method was introduced by doubling the number of derivatives used over the thickness to be calculated. When two succeeding calculations agreed on an energy loss to three places, this was accepted as an answer.

The initial energies used in the calculations were set at 0.5, 1, 1.5, 2, 2.5 ... 10, 20, 30 ... 100, 200, 300 ... 1000 MeV. The calculations checked for a minimum energy, which would allow the particle to just penetrate the required thickness of material. This value was found to within 1 MeV ... The calculations then used the table of values specified to find the energy loss for all higher energies.

Printed output consisted of initial energy, incident energy, final energy, energy loss, number of iterations and percent difference from previous loss.

TITLE:	Integral Evaluations	
AUTHOR:	Tsipouras, P.	
INITIATOR:	Mapleton, R. (LKS)	
PROJECT:	8627	PROBLEM NO. 1072
HARDWARE/SOFTWARE:	IBM 7044/Fortran IV	
MINIMUM CORE SIZE:	21_8k	

Several integrals of the form,

$$Q_i = \int_0^{\pi} \sin\theta \, |I_i|^2 \, d\theta \quad \text{for } i = 1, 2$$

are evaluated.

The I_i's are functions of the angle θ and a parameter E.

The problem was separated into two parts, which have different functions, and Simpson's Rule was used for the integration.

TITLE:	Least-Squares Fit of Temperature vs Resistance
AUTHOR:	Persakis, T.
INITIATOR:	Myers, R. (LY)
PROJECT:	6698 PROBLEM NO. 1073
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE	26_8k

A least-squares fit is performed on a third-degree polynomial representing temperature vs resistance.

The polynomial is of the form,

$$R = e^{\frac{a_0 + a_1 T + a_2 T^2 + a_3 T^3}{T}}$$

where a_0, a_1, a_2, and a_3 are the coefficients of the third-degree polynomial.

The theoretical and experimental data, the residuals, polynomial coefficients, standard error and sum of squares of residuals are calculated and printed.

TITLE:	Diffraction Profile
AUTHOR:	Dieter, K.
INITIATOR:	Szabo, T. (LZM)
PROJECT:	5635 PROBLEM NO. 1074
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	10_8k

A mathematical model is devised to assist in the study of the effect of diffraction on the design of microwave acoustic surface wave devices. In order to make correlations between experimental data gleaned from experiments involving laser beam diffractions and theory, a function representing the real and imaginary parts of the intensity field points is evaluated for the computation of diffraction intensities. The results are printed and plotted on the Calcomp plotter.

TITLE:	Balloon Simulation Flights	
AUTHOR:	Grossman, P.	
INITIATOR:	Keeney, P. (LCA)	
PROJECT:	BLNS	PROBLEM NO. 1075
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	15_8k	

This program simulates a series of balloon flights, using the data from individual soundings. On each flight, the balloon will rise at a given ascent rate until a specified altitude is reached. It will then float at that altitude until either a predetermined X distance is reached or the float time has elapsed. It may then descend or rise to a new altitude and float there until the X distance has been reached. The Y value and total elapsed time are then made available.

The output consists of the input data and the time and Y distance for each applicable sounding on the tape.

TITLE:	Sun Temperature Profile for Solar Supergranulation Cell	
AUTHOR:	Fusco, J.	
INITIATOR:	Beckers, J. (LMO)	
PROJECT:	7649	PROBLEM NO. 1076
HARDWARE/SOFTWARE:	IBM 7044/Fortran IV, MAP	
MINIMUM CORE SIZE:	31_8k	

A temperature profile for a solar supergranulation cell is made. Each supergranulation cell on the solar surface is defined by a polygon. On the solar surface there are about 1000 such polygons, which together form a network that covers the entire solar image. The experimenter measured the density of the solar surface within each of these cells in about 200 points. The result was about 200,000 measurements per measurement sequence. Ten such sequences (photographs) exist, so that a total of two million intensity data exists.

The purpose of this program is to locate each intensity measurement in the cell to which it belongs, to determine the distance S of the point to the center of the cell and to find the intensity minus S-dependence.

In addition, the autocovariance function of the solar image is obtained. This function is defined as

$$AC(\zeta) = \frac{1}{N} \sum_{i=1}^{N} I(p_i)\, I(p_i + \zeta)$$

where I is the <u>difference</u> of the intensity of the average intensity, and N is the maximum number of points over which the product can be taken. The p coordinate in the equation above should be the distance along the solar surface, <u>not</u> the X.

TITLE: Rocket AJ17.616 Aspect Report
AUTHOR: Savage, K.

INITIATOR: Ulwick, J. (LIJ)
PROJECT: 7663 PROBLEM NO. 1077

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 45_8k

To properly analyze the data of certain rocket probles, it is necessary to know the angle between the axis of the probe and some vector in space, such as the velocity vector, the earth's magnetic field vector, or the sun-line vector. The first step in obtaining this angle is the determination of the aspect of the axis of the probe. "RASP" is a program which is part of an operating system to calculate rocket aspect from gyroscopic data transmitted during flight. The data used to find the aspect of a probe parallel to the rocket axis are the corrected pitch and yaw angles. "RASP" calculates the azimuth, elevation and angle of attack of the rocket axis. Altitude and magnetic field data are calculated as a function of time and output along with the angles of attack between the longitudinal axis of the rocket and the velocity and magnetic field vectors. The aspect and other pertinent information concerning the behavior of the rocket are represented in a local cartesian coordinate system with axes in the direction of true north, east, and the vertical.

TITLE: Properties of Solid-State Materials
AUTHOR: Dolan, J.

INITIATOR: Lipson, H. (LQO)
PROJECT: 5621 PROBLEM NO. 1078

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 50_8k

Classical oscillator theory is applied to the analysis of the fundamental lattice vibration reflectivity spectrum of LiF and MgO in the 200 to 800^{-1} wave-number range. For each material, seven reflectivity curves, ranging from 7.5 to 1060°K for LiF and from 8 to 1950°K for MgO, are analyzed, and the associated dispersion parameters as a function of temperature are obtained. The reflectivity curves of both LiF and MgO can be fitted with two resonances at all temperatures. Resonance frequencies ν_1 and ν_2 are decreasing functions, whereas strengths $4\pi\rho_1$ and $4\pi\rho_2$ are increasing functions of temperature. At the higher temperatures, the width of the main resonance γ_1 obeys a $T^{1.0}$ power law for LiF and a $T^{1.5}$ law for MgO. In addition, optical constants, real and imaginary parts of the dielectric constant, and absorption coefficients are calculated as functions of wave number and temperature.

A computer program was written to compare computed values with experimental values of the infrared reflectivity spectra in order to obtain the best curve fit for the dispersion parameters and other optical constants.

TITLE:	Atmospheric Field Measurement of Aerosol Properties	
AUTHOR:	Fusco, J.	
INITIATOR:	Elterman, L. (OPA)	
PROBLEM:	7670	PROJECT NO. 1079
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	32_8k	

Light-scattering measurements from a searchlight beam were recorded in New Mexico to determine the aerosol properties of the atmosphere. A knowledge of atmospheric aerosol properties is necessary for the solution of many research and applied problems. In nearly all of the problems concerned with the interaction of light with the atmosphere, the aerosol attenuation coefficient in the troposphere and stratosphere emerge as an indispensable and little-known parameter. The purpose of this investigation was to determine quantitatively this and related parameters with the use of the searchlight technique. The altitudes of interest were restricted to a height of 35 km, because above this altitude the measurements show that aerosol attenuation can be neglected.

Two programs were written to aid in this investigation of aerosol properties in the atmosphere. Mathematical equations supplied by the researcher were used to calculate the aerosol attenuation coefficients for evaluation. The method used is an iterative process to examine the data for conversion and data stability. The output is a set of attenuation coefficients for specific data samples.

TITLE:	Reduction of Silicon Tetrachloride	
AUTHOR:	Grossman, P.	
INITIATOR:	Rohan, J. (LQD)	
PROJECT:	5621	PROBLEM NO. 1080
HARDWARE/SOFTWARE:	IBM 7044/Fortran IV	
MINIMUM CORE SIZE:	20_8k	

Most open-tube flow processes for epitaxial growth of silicon on silicon substrates employ the hydrogen reduction of silicon tetrachloride. This process has been thoroughly investigated experimentally in terms of silicon growth rate as a function of input silicon tetrachloride mole fraction and temperature. To a lesser degree, the effect of diluting the silicon tetrachloride-hydrogen gas stream with the inert gas helium has been studied.

A program performs calculations using equations supplied by the initiator in order to aid in the investigation of the reduction of silicon tetrachloride as an equilibrium process in the presence of an inert gas helium. The methods of iteration, half-interval search and quadratic interpolation were used.

TITLE: Electron Density Distribution in the Ionosphere
AUTHOR: Atkinson, J.

INITIATOR: Rush, C. (LII)
PROJECT: 5631 PROBLEM NO. 1081

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 25_8k

A previous program done under Problem No. 1610 was modified because it produced an excessive amount of punched card output. This program interpolates for certain values of true height the electron density and the plasma frequency and then punches these values on cards in order to limit the amount of card output.

The original program provided a flexible method of determining the electron density distribution in the ionosphere and printed out values for plasma frequency, electron density and true height. Second height values are picked out, rounded to the nearest ten greater than or equal to that value and then interpolated for the other two quantities for that height and for each height after that in steps of ten.

TITLE: Three-Body Calculations
AUTHOR: Persakis, T.

INITIATOR: Jasperse, J. (LQK)
PROJECT: 5621 PROBLEM NO. 1082

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 67_8k

The physical problem of three particles interacting with one another can be formulated as an infinite matrix equation, the solution of which yields the energy levels of the system. If the wave function is found, all the physical properties of the system can be calculated. The problem is to solve the infinite matrix equation approximately in successive orders of truncation and to compute the approximate energies and wave functions.

This program of calculations is currently being carried out for the Helium-like atoms and the H_2^+-like molecules.

TITLE: Analysis and Simulation Branch Scientific Problem Library
AUTHOR: Healey, F.

INITIATOR: Cronin, E. (SUYA)
PROJECT: 0001 PROBLEM NO. 1083

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 100_8k

A system of computer programs was developed to establish a program library of analytical routines in support of the pure and scientific investigations conducted by the Analysis and Simulation Branch at AFCRL, Hanscom Field, Bedford, Massachusetts. Scientific documentation procedures were developed and implemented for acceptance of completed mathematical routines designed and developed for the Data Analysis Branch in support of research projects at AFCRL.

These programs perform storage and retrieval of information about each "problem number" (which is the number assigned to each task performed for the Analysis and Simulation Branch) for the purpose of providing management reports. These reports provide management with a tool for program scheduling, evaluation of performance, and cost analysis.

When the documentation has been completed and verified, and the program has been classified into one of five categories, the program data is stored in the following manner: (1) the program card decks are placed onto magnetic tape for retrieval when necessary, and (2) selected information about all the completed problem numbers is placed in the PLIF (Program Library Information File), from which it is possible to retrieve a variety of lists for management use.

TITLE: Visibility Statistics - Line of Sight
AUTHOR: Almon, A.

INITIATOR: Bertoni, E. (LKI)
PROJECT: 8624 PROBLEM NO. 1084

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 41_8k

This program will provide the user with visibility statistics for the following altitudes: lower than 2500, 2500 to 4999, 5000 to 9999, 10,000 to 14,999, 15,000 to 24,999, 25,000 to 34,999, 35,000 to 44,999, and higher than 45,000 ft. The data was calculated from observations made from aircraft at angles to the horizon and +30, +60, -30 and -60 deg to the horizon. All observations have been put onto magnetic tape for easier handling.

A data summation of three categories is made and their sums are totaled. This final total is divided into the clear line-of-sight total (category 1), and the probabilities of clear line-of-sight are printed out. This procedure is continued for each angle and the horizon for every altitude grouping.

TITLE:	Expansion of a Gas Cloud into a Vacuum
AUTHOR:	Tsipouras, P.
INITIATOR:	Marcos, F. (LKB)
PROJECT:	8605 PROBLEM NO. 1085
HARDWARE/SOFTWARE:	Not Applicable
MINIMUM CORE SIZE:	Not Applicable

Studies of the release of sodium vapor at a height of 430 km have shown that the structure (density) of the gas cloud is not explained by present theories. Sodium trails released at lower altitude (where collisions between the sodium atoms and ambient atmosphere are not negligible) have a Gaussian distribution when number density is plotted against distance along the trail. Theories of the collisionless expansion of a gas cloud indicate that their structure should also be Gaussian. However, experimental data for the 430 km release show a torus-like shaped structure. The present work is to attempt to compare these data with the mathematical solution of the wave equation, with appropriate conditions.

TITLE:	Evaluation of a Convolution Integral for Spectrometer Response
AUTHOR:	Grossman, P.
INITIATOR:	Manson, J. (LKO)
PROJECT:	6688 PROBLEM NO. 1086
HARDWARE/SOFTWARE:	IBM 7044/Fortran IV
MINIMUM CORE SIZE:	30_8k

This problem finds the response of a proportional counter spectrometer for measurements of solar x-rays by evaluating a convolution integral. The spectrometer was designed so that the detector and its associated circuitry could be mounted as auxiliary equipment on a telemetering monochromator that is flown in an Aerobee Hi rocket and pointed at the sun. The spectrometer analyzes solar radiation in five intervals of wavelength between about 0.8 and 10 Angstroms.

The transmission vs wavelength curves of a number of shaping functions (or filters) and a number of values were supplied. The curves were created from these values.

TITLE:	Error-Decoding Probabilities	
AUTHOR:	Pustaver, J.	
INITIATOR:	Hobbs, C. (LRD)	
PROJECT:	4610	PROBLEM NO. 1087
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	40_8k	

The problem was to calculate the probability of events connected with the decoding of binary coded words by a decoder which filters each signal, treats ambiguous signals as blanks, and attempts to fill in the blanks by checking a set of parity check equations for even parity.

The probabilities to be calculated are as follows:

P1: Probability of correct decoding.
P2: Probability of rejection due to detection of errors.
P3: Probability of rejection due to detection of blanks.
P4: Probability of one or more errors and acceptance by decoder.

The two methods used for computing the probabilities involve the Gaussian Channel and Rayleigh Fading.

TITLE:	Computation of Periodic Values	
AUTHOR:	Grossman, P.	
INITIATOR:	Chernosky, E. (LKA)	
PROJECT:	8601	PROBLEM NO. 1088
HARDWARE/SOFTWARE:	IBM 7044/Fortran IV	
MINIMUM CORE SIZE:	50_8k	

Huancayo station data consisting of consecutive hourly values by days for the years 1923 to 1962 is contained on a BCD type 3 magnetic tape.

The data is checked for consistency, and the daily moving averages for each month are computed and tabulated. The type of moving average computed varies according to the requirement, and the parameters of the moving average are varied to take into account missing data.

Each monthly mean appears at the foot of its respective column, and the yearly average is printed at the bottom of the page. If there is missing data, the number of hours for which data was available is printed directly to the right of the average concerned.

TITLE:	Statistical Summary of Satellite Radio Scintillation Data
AUTHOR:	Hoffman, R.
INITIATOR:	Allen, R. (LIR)
PROJECT:	4643 PROBLEM NO. 1089
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	37_8k

Pertinent scintillation is selected from card image files; old-format data is converted to a new format, combined with new-format data, and arranged in chronological order.

A statistical summary of satellite radio scintillation data is given. The following quantities are determined:

a. Number of observations
b. Total Faraday period
c. Mean Faraday period
d. Mean scintillation
e. Mean scintillation-Faraday index

The analysis can be controlled by these parameters, magnetic index, subionospheric longitude or latitude, and year or hour of observation in some or all of these programs. Also, the data is analyzed by month and hour of observation.

Then a statistical summary of radio scintillation data is obtained. Both the differential and the integral distributions of the scintillation index are determined. The analysis can be controlled by the following parameters:

a. Magnetic index
b. Subionospheric longitude
c. Subionospheric latitude
d. Year of observation

Finally, the distribution of the magnetic index values in a scintillation data card file is determined.

TITLE: Fourier Analysis of Artificial Target Pulses
AUTHOR: Dieter, K.

INITIATOR: Zawalick, E. (PHG)
PROJECT: 8601 PROBLEM NO. 1090

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 77_8k

A program was originally written by the initiator to generate a set of pulse waveforms (some of a Gaussian nature) which simulate a magnetic signal as detected by a moving aircraft approaching the target from an arbitrary direction. Additional programming was designed to take a simple Fourier Transform of each pulse and plot its amplitude as a function of ft/sec. The artificial input data was generated using a formula which contained several input parameters, which in turn control the actual shape of the pulse. In many cases a Gaussian-shaped curve was obtained. Generally, the result was a spike near the low frequency end of the spectrum. Although the data analyzed was artificial pulses, the program can easily handle real data. The fast Fourier Transform procedure used is described in the IBM Scientific Subroutine Package-Version II or III; or in Cooley and Tukey, "An Algorithm for the Machine Calculation of Complex Fourier Series," Mathematics of Computation, Vol. 19 (April, 1965), p. 297.

TITLE: Evaluation of Rotational Temperatures
AUTHOR: Persakis, T.

INITIATOR: Anctil, R. (OPR)
PROJECT: 5710 PROBLEM NO. 1091

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS; CDC 6600/Fortran IV
MINIMUM CORE SIZE: 51_8k

Four programs evaluate rotational temperatures.

The relative intensity of rotational spectral lines is computed as a function of the particular molecular band, the appropriate vibrational constant, and the temperature. One program computes the relative intensities of rotational spectral lines in the R branch of particular molecular bands, and another computes the intensities in the branch of the molecular bands.

This calculation is based on well established physical theory, and is independent of the experimental method of investigation.

Two other programs use the output from the above programs to compute synthetic intensity distribution, which would be measured by a particular experimental apparatus. This calculation is empirical and uses as inputs the theoretical relative intensity of spectral lines previously calculated plus an empirical instrumented transfer function.

TITLE: Probability of Atomic Displacement
AUTHOR: Grossbard, N.

INITIATOR: Kantor, G. (LIB)
PROJECT: 5620 PROBLEM NO. 1092

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 50_8k

Many problems in the field of radiation damage in crystalline materials are related to the calculation of the number of atoms displaced by energetic radiations. An essential parameter in such calculations is the effective threshold energy for atomic displacement. At the present time it is not possible to derive an accurate value for this threshold energy from theory, but it can be measured experimentally. The experimental approach consists of determining the rate of electron bombardment-induced damage as a function of electron energy, and comparing the results with cross sections calculated for a range of different threshold energies.

In deriving atomic displacement threshold energies from electron bombardment data, it is necessary to employ numerical values of the electron scattering cross section calculated over a range of electron energies. For relativistic energies, the Mott-Rutherford cross-section formula may be used.

A computer program was developed to evaluate this formula for any value of atomic number and electron energy.

A second program finds the cross sections for atomic displacements produced by electrons by the method of numerical integration of Mott scattering cross sections.

TITLE: New Adaptive Simpson Integration Routine
AUTHOR: Grossbard, N.

INITIATOR: Aarons, J. (LIR)
PROJECT: 4643 PROBLEM NO. 1093

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 31_8k

Two programs were written to check out a new adaptive Simpson integration routine. The programs are identical, except that one uses double-precision arithmetic and the other uses single-precision arithmetic.

The integral,

$$\int_0^1 \frac{x}{(e^x-1)}\,dx$$

is evaluated. A value representing the error within which the integral is to be evaluated is input. The values of the integrands at the various intervals are printed.

TITLE: Rocket AJ17.617 Aspect Calculation
AUTHOR: Fioretti, P.

INITIATOR: Ulwick, J. (LIJ)
PROJECT: 7663 PROBLEM NO. 1094

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 40_8k

"RASP" is part of an operating system to calculate rocket aspect from gyroscopic data transmitted during flight. The corrected pitch and gyroscopic data from rocket number AJ17.617 is input to "RASP," which calculates the azimuth, elevation, and angle of attack of the rocket aspect. Altitude and magnetic field data are calculated as a function of time and output with the angle of attack between the longitudinal axis of the rocket and the velocity and magnetic field vector.

TITLE: Wind Structure Function
AUTHOR: Dabcovich, M.

INITIATOR: Zimmerman, S. (LKC)
PROJECT: 8605 PROBLEM NO. 1095

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE. 40_8k

A program was written to solve two problems.

The first problem involves the calculation of the wind structure function from a given expression. Two curves, W_1 and W_2, representing the actual (measured) wind profile, respectively, were supplied. They were digitized to .2 km intervals and plotted with the height in km vs speed. The "residual wind profile," which is the difference between W_1 and W_2, was calculated.

In the second part of the program, the vertical gradient (three-dimensional) of the wind speed was determined. The initiator supplied the magnitude of the wind and its heading, plus the vertical separation of the readings.

TITLE:	Calc..'..ion of the Production of Ionization	
AUTHOR:	Gerbes, I.	
INITIATOR:	Sales, G. (LII)	
PROJECT:	5631	PROBLEM NO. 1096
HARDWARE/SOFTWARE:	IBM 7044/Fortran IV	
MINIMUM CORE SIZE:	21_8k	

Two programs calculate the production of ionization at any altitude from i :oming electrons of a specified energy spectrum.

The problem is divided into two parts. The first program computes

$$\frac{Q\ (Z,\ EO)}{PHI\ (EO)}\ .$$

The second program reads the tape created above, sorts the data according to height, multiplies by PHI (EO), and then integrates by the trapezoidal rule.

The final output consists of the values for flux, energy, th : nent, altitude, number of points, the integral, and the first value of th : ..

TITLE:	Xenon Light Source Normalization and Corrections	
AUTHOR:	Persakis, T.	
INITIATOR:	D.mond, N. (PHF)	
PROJECT:	8659	PROBLEM NO. 1097
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	45_8k	

A program "GLASS" was written to do normalization of a Xenon Lamp Source used for monochromatic light studies. Correction factors are applied at particular wavelengths in the visible region of the spectrum between 300 to 600 millimicrons. Final output included plots of the co:rected photocurrent vs wavelength.

TITLE:	Generation of Solar and Lunar Ephemerides	
AUTHOR:	Bhavnani, K.	
INITIATOR:	Buchau, J. (LIB)	
PROJECT:	5631	PROBLEM NO. 1098
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV	
MINIMUM CORE SIZE:	45_8k	

Program "SOLAR," originally developed under Problem No. 1131, was converted from the IBM 7094 II-7044 DCS to the CDC 6600. The converted version was designed for batch processing, and under this problem number, is adapted for operation on the CDC 6600 Intercom three system from teletype terminals.

Given local location and altitude plus universal time, local solar azimuth and unrefracted elevation are computed for any time intervals desired from 1900 to 1999. The elevation corrected for refraction is also computed. Output consists of each time increment in universal time, the corresponding local solar azimuth, and the local solar corrected (unrefracted) and uncorrected (refracted) elevation.

TITLE:	Spectral Scan Plots	
AUTHOR:	Abelowitz, A.	
INITIATOR:	Heroux, L. (LKO)	
PROJECT:	6688	PROBLEM NO. 1099
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	43_8k	

"CHANPLOT" creates Calcomp plots of spectral scans in the ultraviolet region. The program has been designed to allow flexibility in specifying plot output.

The data is accessed from an input magnetic tape by a specified channel, and wavelength values along the x-axis are plotted vs data points on the y-axis. The program has the following options, capabilities and limitations:

a. Plots up to 3600 data points.

b. Smooths the input data, using a two-point running average method.

c. Varies the horizontal and vertical scale.

d. Redefines the vertical scale if the plot exceeds paper limitations.

e. Creates more than one plot per run.

f. Spaces each plot three inches apart.

TITLE: Wavelength for Crystal Growths
AUTHOR: Cronin, E.

INITIATOR: Field, W. (LQP)
PROJECT: 5621 PROBLEM NO. 1100

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 21_8k

The conversion of x-ray diffraction angles of interplanar spacings was accomplished utilizing Braggs law. The results generated were output in a particular format that was practical and aesthetic for purposes of photographic reduction for report usage.

Braggs law, which gives wavelengths of crystal materials, is stated as follows:

$$n\lambda = 2d \sin \theta$$

where

n = 1

d = value of spacings in angstrom units corresponding to angle θ

θ = values of angles (in degrees), which are measured when diffraction patterns are used for chemical identification and crystal structure determination.

TITLE: Table of Atmospheric Calculations
AUTHOR: Gerbes, I.

INITIATOR: Nee, P. (LKI)
PROJECT: 8624 PROBLEM NO. 1101

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 53_8k

The object of this project was to calculate the temperature, density, coefficient of viscosity, thermal conductivity and the speed of sound for given heights of the atmosphere by a model which was supplied. Some of these values are then printed out in a neat table along with comparisons between the calculated atmosphere and a "Standard Atmosphere."

TITLE: Schröedinger Wave Equations
AUTHOR: Russell, J.

INITIATOR: Eyges, L. (LQD)
PROJECT: 5621 PROBLEM NO. 1102

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 14_8k

An integral was evaluated numerically using Simpson's Rule to aid in the analysis of the solution of the Schröedinger wave equations for arbitrary potentials.

This integral was evaluated in two ways. First, the function was to be nume ally integrated with respect to one of the variables for each value of the other varia le over the interval of definition. Second, the same function was numerically integrated in the exact manner, but with the roles of the two variables interchanged.

The two functions are expressed as follows:

$$f_1 = \int_{y^1}^{y^2} \sin y \sqrt{y-z}\; e^{-y^2-y\sqrt{z}}\, dy$$

$$f_2 = \int_{z^1}^{z^2} \sin y \sqrt{y-z}\; e^{-y^2-y\sqrt{z}}\, dz$$

The output was comprised of the independent parameter and the value of the integral for each incremental value of the dependent variable.

TITLE:	Sunshine and Synodical Decimal Data Editing
AUTHOR:	Guarente, J.
INITIATOR:	Lund, I. (LKI)
PROJECT:	8624 PROBLEM NO. 1103
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	45_8k

Four programs perform editing and correcting of sunshine data and synodical decimal daily data, gathered from the year 1896 to 1969, in order to determine if a relationship exists between the two types of data.

"SAPPORO" lists data cards containing either sunshine data or synodical decimal data from 1896 to 1969, a value for each day of the year. This listing is used to check the data for errors, because of its unreliability. This data is then placed on tapes, one containing sunshine data, and the other containing synodical decimal data.

"PH" is a program broken up into four parts, "PH1" - "PH4." Here, only "PH1" is described, because the others have only minor differences. "PH1,"

a. finds the 31-day average of the Sapporo sunshine data,

b. finds the average number of hours and sample size for a given period of synodical decimal (four periods for four programs),

c. calculates the 31-day moving of b,

d. finds the ratio of c to a.

"DEC-SHINE" lists the synodical data from the Sapporo sunshine data side-by-side for each day of the year from 1896 to 1969. The output tapes from "SAPPORO" are input.

"AVE-SHINE" accomplishes two tasks. The first is the scanning of the "SAPPORO" sunshine data for any values greater than 160, and these values are printed. The second task is to find the average sunshine for each day of the year from 1896 to 1931, excluding missing days and values greater than 160.

TITLE:	Energy Spectra of High Energy Solar Protons	
AUTHOR:	Doherty, R.	
INITIATOR:	Ulwick, J. (LIJ)	
PROJECT:	7663	PROBLEM NO. 1104
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	72_8k	

Three programs assist physicists in determining the energy spectra of high energy solar protons in cap events.

"IDES-1" computes a number of double integrals and stores these values on tape for input to "IDES-2."

"IDES-2" computes the necessary spectra coefficient values of an over-conditioned linear system. These coefficients are input to "IDES-3."

"IDES-3" computes final spectra formulas from the data generated by the two programs mentioned above.

The final output is a printed list of the spectra formulas as a function of altitude. Also, intermediate results are printed, and a printed graph shows how the energy deposition values vary as a function of altitude.

TITLE: Wave Decomposition by Fitting Meteorological Data
AUTHOR: Dabcovich, M.

INITIATOR: Kreitzberg, C. (LYS)
PROJECT: 6698 PROBLEM NO. 1105

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 25_8k

Time series of data were originally fit to third and fifth-order polynomials by a least-squares fit. The meteorological data acquired at six stations at different times and levels included temperature, wind direction, wind speed, pressure and static energy. This data, together with the date, time, highest data level, lowest data level and site identification, was corrected, checked and processed into 43 different sets. After repeated tests and testing up to 17th degree polynomials, it was found that 11th degree polynomials gave the best results. The output consisted of the following: (1) listing of input data; (2) listing of computed data, polynomial fit, difference between data and fit, standard deviations; (3) listing of computed polynomial coefficients; (4) punched output of coefficients. The above output was given for all stations.

A complication encountered was the handling of missing data or out-of-bounds and rejected data. These discrepancies were replaced by and treated as blanks. An automatic procedure to compute polynomials with unequally spaced ordinates and to print blanks instead of zeros had to be written into the program.

After results of the polynomial fit were ascertained, computations were done for geostrophic winds, ageostrophic winds, vorticity, divergence, vertical velocity, non-advective temperature change, speed acceleration and curvature. These computations result from combinations and integrations of the computed quantities.

TITLE:	Vibration Study Using Rayleigh-Ritz Method
AUTHOR:	Martine, J. and Hoffman, R.
INITIATOR:	Mansfield, T. (LCR)
PROJECT:	6020 PROBLEM NO. 1106
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	20_8k

Three programs "IMATRX," "JMATRX," and "AXLBX" are used to find the resonant vibrational modes of a small sounding rocket by the Rayleigh-Ritz method. In the first two programs, integration is done using the Newton-Cotes 4th-order algorithm, which is a form of Simpson's algorithm with error reduction. As used, the integration starts using four "panels." The estimated relative error is compared with a specified tolerance, and if the error is greater, the number of panels is doubled. This cycle is repeated until the error is less than the specified tolerance, or the maximum number of panels specified is reached. Also contained in these programs is a routine which interpolates values in a table of functional values, based on interpolation by iteration of proportion parts without the use of differences.

Program "AXLBX" finds the eigenvalues and eigenvectors of a real symmetrix matrix using Jacob's method as modified by Von Neuman, et al. To circumvent overflows occurring in these calculations, it was necessary to multiply matrix values by a scaling factor. The resulting eigenvalues were divided by the scaling factor following calculation, and the eigenvectors were unaffected as they were normalized.

The principal work effort optimized the logical flow of the programs and the mathematical routines; and it digitized the graphical data.

TITLE:	Tabulation of Double Integrals Related to Fresnel's Integrals
AUTHOR:	Kellaher, J.
INITIATOR:	Cronin, E. (SUYA)
PROJECT:	0001 PROBLEM NO. 1107
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	24_8k

The objective of this work effort was to tabulate certain integrals related to Fresnel's integrals, which occur repeatedly in calculation for a number of AFCRL research projects. The program computes and tabulates a set of iterated integrals related to other Fresnel integrals

$$c(t) = \int_0^t \frac{\cos U\, du}{(2\pi U)\ 1/2} \text{ and } s(t) = \int_0^t \frac{\sin U\, du}{(2\pi U)\ 1/2} .$$

The required integrations are done in three sections, each of which may be run independently of the others. Integrals are evaluated for values in a set chosen to correspond to the arguments for the Fresnel Integrals in the Jahuke-Emde Table of Functions. The integrals of integration are broken into subintervals and the integration is done over each subinterval. This is done by the recurrence formula and the integrals are computed by the Ralston Method of numerical integration applied once to each integral. The various integrands are computed by suitable approximation methods, and no numerical evaluation of the Fresnel integrals is used. While the program does what was required, it contains two fairly general numerical integration subroutines and one other double precision subroutine for the Fresnel integrals.

Reference: Fresnel Integrals and the Boersma Approximation,
J. Boersma, Computation of Fresnel Integrals
Math of Comp, XIV, 1960, p. 380.

TITLE: ANNA-1B Doppler Data Storage
AUTHOR: Hussey, I.

INITIATOR: Hadgigeorge . (LWG)
PROJECT: 7600 PROBLEM NO. 1108

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 7_8k

This task involved the archiving of doppler data acquired during the active phase of Satellite #446 (ANNA-1B), a Navy Weapons Laboratory (NWL) vehicle. A data retrieval program was written to select observations from storage by specified station numbers.

TITLE: Cosmic Noise Study in Ionospheric Absorption
AUTHOR: Dieter, K.

INITIATOR: Tomas, K. (LII)
PROJECT: 5631 PROBLEM NO. 1109

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 60_8k

"NOISE" was written to aid in the study of ionospheric absorption during the precipitation of energetic particles in April, 1965. Two sets of data are cross-correlated, using the lagged-products method. The results obtained helped to make an assessment of the regional behavior of this absorption.

The output consists of (1) printout of number of data values, number of correlation values, input data, and cross-correlation, and (2) plots of cross-correlation vs time.

The principle mathematical technique used is that of computing the correlation between two sets of data using the lagged-products method. A standard subroutine was used, but slightly modified so that the correlations are properly normalized. Input data was restricted to a maximum of 1500 values/station.

TITLE: Ionization Yield of Nitrogen
AUTHOR: Meehan, P.

INITIATOR: Sheridan, W. (LKS)
PROJECT: 8627 PROBLEM NO. 1110

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 14_8k

The ionization yield of nitrogen between 600 and 800Å was calculated every .0125Å and the wavelength was calculated at each point.

The final values were plotted on the CRT plotter. Twenty-five plots of absorption cross-section yield vs wavelength in angstroms were output, one plot for each scan in each roll.

TITLE: Mie-Scattering Analysis
AUTHOR: Grossman, P.

INITIATOR: Fenn, R. (OPA)
PROJECT: 7621 PROBLEM NO. 1111

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 20_8k

Three programs were designed to calculate the cross sections for light scattering by partially-absorbing or non-absorbing spheres. This type of scattering is generally termed "Mie-Scattering," and is done by "RRA-45."

The intensity of the light scattered by aerosol particles is highly dependent on the index of refraction, wavelength of the incident light and the particle size distribution. For a given index of refraction, cross sections for Mie scattering by spherical particles can be calculated as a function of the size parameter $X = 2\pi r/\lambda$, where r is the radius of the particle and λ is the wavelength of the incident light. "RRA-45" performs such calculations.

"RRA-56" is designed to facilitate preparation of input data for "RRA-45." When inputting an aerosol size distribution in tabular form in "RRA-45," the size distribution must be defined at exactly those values of radius dictated by the size parameters and wavelengths used, by

$$R = \frac{x\lambda}{2\pi} \quad \begin{array}{l}(x = \text{size parameters,}\\ \lambda = \text{wavelength}).\end{array}$$

TITLE: Systems Antenna - Paper Tape Control
AUTHOR: Dalton, L.

INITIATOR: Klobuchar, J. (LIR)
PROJECT: 4643 PROBLEM NO. 1112

HARDWARE/SOFTWARE: IBM 7044/Fortran IV, MAP
MINIMUM CORE SIZE: 50_8k

The Antenna Tape Control program was designed to produce a paper tape (8 channels), which would contain velocity data in terms of azimuth and elevation for radio stars, the sun and the moon.

This paper tape, read by any control device, facilitates the data being fed to an automatic type of antenna-positioning equipment. The positioning device feeds the information to the coordinate axes of the antenna, and allows the antenna to track the radio star, the sun or the moon automatically.

TITLE: Spectral Analysis of Sunspot Numbers
AUTHOR: Grossbard, N.

INITIATOR: Toman, K. (LII)
PROJECT: 5631 PROBLEM NO. 1113

HARDWARE/SOFTWARE: IBM 7044/Fortran II
MINIMUM CORE SIZE: 15_8k

This program analyzes the Fourier spectrum of some data flux through atmosphere supplied by the initiator. The power spectrum is found by finding the coefficients of the sine and cosine expansion of the data. The program prints the square root of the sum of the squares of the coefficients of the sine and cosine series for a particular frequency. The results are then graphed linearly and logarithmically.

TITLE: Continuity Equation Solution
AUTHOR: Pustaver, J.

INITIATOR: Rush, C. (LII)
PROJECT: 000D PROBLEM NO. 1114

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 21_8k

The results of M.F.K. Abur-Robb and D.W. Windle, as reported in the abstract from the paper entitled "On the Day and Night Reversal in Nm F2 North-South Asymmetry, "from Planetary Space Sciences, Vol. 17, 1969, pp 97-106, are reproduced by this program.

The program obtains a time-varying solution of the full-continuity equation for electrons in the F2-region, taking into account the effects of production, loss, diffusion and electrodynamic EXB drift. Also included are the effects of transequatorial neutral wind.

Output includes the input values for electrodynamic drift amplitude (W); constant related to sunspot conditions (β); ratio of the scale heights of atomic oxygen and neutral gas (λ); constant scale height of the neutral ionizable gas (H); constant velocity of a transequatorial neutral wind directed horizontally everywhere (V_a); solar declination angle (δ); and the ratio $\gamma = H^2 e^{Z/H}/DT$, where D is the coefficient of diffusion.

The Crank-Nicholson finite difference method scheme is used. The system is solved for $0 < X < 1$ and $-1 < X < 0$ limits simultaneously, and the value of V at $X = 0$ is determined by third-order Lagrangian interpolation. At $X = 0$, the condition $\frac{\partial V}{\partial X} = 0$ is assumed.

TITLE: Complex Dielectric Constant of a Liquid
AUTHOR: Pustaver, J.

INITIATOR: Theodorou, I. (PHF)
PROJECT: 8659 PROBLEM NO. 1115

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 20_8k

Data concerning the input impedance of a transmission line filled with liquid is experimentally collected and then used by a program to determine the complex dielectric constant of that liquid. The program solves the complex transcendental equation which related the dielectric constant to the input impedance of the transmission line. The method used consists of stepping around the perimeter of the region, evaluating the function at each point and determining the number of times that the function winds around the origin. This method gives the number of roots in the region. Successively smaller regions are taken until each root is isolated. Reference: Cain, "A Method for Locating Zeroes of Complex Functions," Communications of the ACM, April 1966, pp. 305-306.

The program could be modified to find complex roots of other functions within a region.

TITLE: Magnetogram Data Storage
AUTHOR: Roehrig, H.

INITIATOR: Chernosky, E. (LKA)
PROJECT: 8601 PROBLEM NO. 1116

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS, IBM 1460/Fortran IV
MINIMUM CORE SIZE: 10_8k

A system of programs was developed to implement a change in the method of permanent storage of variable area film magnetograph data from IBM punched cards to magnetic tape, and the format of storage from three sets of film data per deck to film data by station letter in order by film number, date and time on magnetic tape.

The system is designed to process one reel of tape containing not more than 10 decks of raw data. The printed output from each program in the system collectively represents a historical documentation in sufficient detail to present a synoptic picture of the conversion of permanent data storage from punched cards to magnetic tape.

The program system includes the following:

a. Card-to-tape program
b. Edit card image data (MAGEDT)
c. Correct card images on magnetic tape (TAPCOR)
d. Separate film data fields stored on punched cards (MAGDA)
e. Sort film data in time order (MAGSRT)
f. Recollect film data by station letter on separate magnetic tapes (MAGDAT)
g. Maintain and update station master file tapes (MAGDRG)

TITLE: Soil Moisture Prediction
AUTHOR: Carbone, J.

INITIATOR: Lund, I. (LKI)
PROJECT: 8624 PROBLEM NO. 1117

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 75_8k

Trafficability, the ability of a soil to permit the movement of vehicles, is a function of soil strength. Soil strength is related to soil moisture, which in turn is related to many other variables, such as soil type, drainage and vegetation. For the preparation of an accurate estimate of the effect of climatology on soil strength conditions, a long-time record of soil-moisture measurements is required. For most areas in the world, no such record exists.

In program "REL FREQU," equations developed for estimating soil moisture in sandy silt of the type found in low terraces in the Saigon area are used in conjunction with a 22-year record of daily rainfall observations to generate a soil moisture record. From knowledge of soil moisture-strength relationships, a soil strength record is generated. This record is used to estimate, for each day of the year, the probability that a given type of vehicle will be able to execute severe maneuvers over the soil without becoming immobilized.

TITLE: Processing of Data from Paper Tapes
AUTHOR: Dabcovich, M.

INITIATOR: Rasmussen, J. (LIE)
PROJECT: 4603 PROBLEM NO. 1118

HARDWARE/SOFTWARE: IBM 7044/Fortran IV, IBM 1460
MINIMUM CORE SIZE: 77_8k

This task consists of: (1) transcribing paper tape (8 channel) to magnetic tape on IBM 1460; (2) utilizing printer graph technique for information plotting; (3) editing, sorting, deleting selected areas of information for Calcomp plot displays.

TITLE: Effect of Space Charge Limitations on Electrodes Emissions
AUTHOR: Atkinson, J.

INITIATOR: Gianino, P. (LQR)
PROJECT: 5710 PROBLEM NO. 1119

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV, MAP
MINIMUM CORE SIZE: 14_8k

The purpose of this problem was to calculate the effect of space charge limitations on emissions from electrodes with two electrodes emitting simultaneously. The effects are due to both thermionic and secondary electron emissions. Three similar programs are used to produce the desired output.

These programs can also be used for the integration of any real-valued function of a single real variable.

TITLE:	Lunar Position Computation	
AUTHOR:	Grossbard, N.	
INITIATOR:	Eckhardt, D. (LWG)	
PROJECT:	8554	PROBLEM NO. 1120
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV	
MINIMUM CORE SIZE:	50_8k	

Calculations were performed to compute accurate coordinates of points on the moon's surface in order to determine the exact position of the moon. In order to provide the best possible accuracy, a likelihood method was used. This method involves solution of a very large matrix equation, the inversion of which is solved through use of a double integral equation solution.

TITLE:	Geophysical vs Atmospheric Parameter Correlations	
AUTHOR:	Grossman, P.	
INITIATOR:	Glass, M. (LYC)	
PROJECT:	8620	PROBLEM NO. 1121
HARDWARE/SOFTWARE:	IBM 7044/Fortran IV	
MINIMUM CORE SIZE:	24_8k	

The program calculates the mean and standard deviation of each list of nine variables (A through I), as well as the cross-correlations and computation of the standard error of estimation. Output includes (1) a list of the variables for verification; (2) lists of the mean and standard deviations and the number of observations; (3) correlation coefficients, standard errors of estimation, and the number of pairs used for these computations, each of these lagged for 0, 2, 6, 10 and 14 da s.

TITLE: Evaluation of Complex Differential Expressions
AUTHOR: Tsipouras, P.

INITIATOR: Marcos, F. (LKB)
PROJECT: 8605 PROBLEM NO. 1122

HARDWARE/SOFTWARE: Not Applicable
MINIMUM CORE SIZE: Not Applicable

This is a pure mathematical analysis, involving no programming, to test for convergence of the improper integral:

$$I_4(x) = \int_o^b \frac{\cos t \cdot C(t)}{(2\pi t)^{3/2}}\, dt$$

where $b > o$ and $C(t)$ is the Fresnel integral

$$C(t) = \int_o^t \frac{\cos t}{\sqrt{2\pi t}}\, dt$$

The improper integral, when tested for convergence, facilitates evaluation of complex differential expressions.

TITLE: Index of Refraction of an Electron Plasma
AUTHOR: Dieter, K.

INITIATOR: Horowitz, S. (LII)
PROJECT: 5631 PROBLEM NO. 1123

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 41_8k

This program calculates the index of refraction of an electron plasma subject to an applied magnetic field at a specified angle. The index is found by solving for the roots of the quadratic equation: $An^4 - Bn^4 + C = 0$. The equations used are derived from Budden's book on the ionosphere and, as implemented in the program, can be applied to any situation in which plasmas are involved in ionospheric processes.

TITLE: Wind Velocity - Balloon Trajectory Analysis
AUTHOR: Fusco, J., and Wright, B.

INITIATOR: Lund, I. (LKI)
PROJECT: 8624 PROBLEM NO. 1124

HARDWARE/SOFTWARE: IBM 7044, IBM 7094 II-7044 DCS/Fortran IV, MAP
MINIMUM CORE SIZE: 16_8k

Wind current data compiled by the Strategic Air Command (SAC) was used to plot trajectories for balloons released at predefined locations and altitudes. Two sets of programs comprise the programming system required to process and analyze the balloon climatology data in order to predict these trajectories. Each set of programs includes a series of MAP and Fortran IV subprograms and a series of subroutines received from SAC which were converted and modified for use on an IBM 7044 computer.

Mathematical computations include wind interpolation in time, balloon positioning, grid spacing correction, selected trajectories, general seasonal trajectories, and general trajectory climatology.

An additional program was written for general use to take a second degree polynomial, a curve of the form $A + BX + CX^2$, and compute a least-squares fit to ten data points. This fit is done by creating a set of orthogonal polynomials over the ten data points.

TITLE: Supergranulation Reduction
AUTHOR: Dalton, L.

INITIATOR: Beckers, J. (LMO)
PROJECT: 7649 PROBLEM NO. 1125

HARDWARE/SOFTWARE: IBM 7044/Fortran IV, MAP
MINIMUM CORE SIZE: 10_8k

Data tapes produced by Problem No. 1076 and containing supergranulation information on different cells are processed to generate the following:

a. A histogram of cell areas in terms of z-groupings, which indicate how well the cell was defined on the original photograph.

b. A cell group listing, which gives the average brightness for certain intervals and the number of points used to obtain brightness for five groups of cells.

c. A combination listing, which gives the groups that are distinguished by the following properties:

(1) cell number
(2) number of corners
(3) x-coordinate of center of gravity
(4) y-coordinate of center of gravity
(5) area of cell.

TITLE: Three-Particle Quantum Mechanical Systems
AUTHOR: Grossbard, N.

INITIATOR: Jasperse, J. (LQR)
PROJECT: 5621 PROBLEM NO. 1126

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 40_8k

Work performed on a program written by Dr. L. Calabi of Parke Mathematical Laboratories, Inc., is continued under this problem number.*

"L" values are calculated for the evaluation of certain volume integrals needed for the bound-state, three-body problem. The techniques developed for the computation of residues have broad applicability.

*1. L. Calabi, "Algorithms for the Evaluation of Certain Integrals Appearing in Three-Body Problems," Final Report, March 1970, Contract F19628-68-C-0061, with Parke Mathematical Laboratories, Inc.

2. L. Calabi, "Toward a Program for the Computation of the T-integrals," Technical Memorandum No. 9, July 1969, Contract F19628-68-C-0061, with Parke Mathematical Laboratories, Inc.

3. L. Calabi, "The Integration of Certain Volume Integrals Required in Three-Body Calculations," Scientific Report No. 1 (AFCRL-69-0021), December 1968, Contract F19628-68-C-0061.

TITLE: Ultraviolet Radiation Studies
AUTHOR: O'Brien, J.

INITIATOR: Weeks, L. (LKB)
PROJECT: 8605 PROBLEM NO. 1127

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 21_8k

"ABSORB" aids in the determination of the carbon dioxide (CO_2) content in the upper atmosphere. The density of CO_2 in the upper atmosphere influences the absorption of a selected band of ultraviolet radiation. This absorption results in a certain altitude and wavelength dependence in the sunlight intensity.

However, the sunlight intensity cannot be measured directly. Rather, the current response of a photodetector located in a satellite is measured. From the altitude dependence of the current response, information is obtained on the CO_2 content of the upper atmosphere. "ABSORB" calculates the current response of the photodetector.

Output consists of (1) all the input data, (2) net current response for selected wavelengths vs altitude, (3) CO_2 current response for selected wavelengths vs altitude, (4) percent of CO_2 influence for selected wavelengths vs altitude, (5) total current response for all wavelengths vs altitude, (6) CO_2 current response for all wavelengths vs altitude (7) percent of CO_2 influence for all wavelengths vs altitude.

TITLE:	Atmospheric Tidal Oscillations	
AUTHOR:	Powell, P.	
INITIATOR:	Zimmerman, S. (LKB)	
PROJECT:	7635	PROBLEM NO. 1128
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV	
MINIMUM CORE SIZE:	45_8k	

The theoretical wind and temperature oscillations, which are due to the diurnal tide, are portrayed graphically. The data is expressed as amplitude and phase for many altitudes.

Program "WIND" calculates, for each altitude, the sinusoidal time variation for preselected times, and then outputs the altitude distribution for wind amplitude and temperature.

TITLE:	OV3-2 RPA Playback Data Analysis	
AUTHOR:	Fioretti, R.	
INITIATOR:	Sandock, J. (LIJ)	
PROJECT:	7663	PROBLEM NO. 1129
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	60_8k	

The OV3-2 satellite Retarding Potential Analyzer (RPA) plot program was written to display the final plots of the RPA tape-recorded data for a particular given format.

The purpose is: (1) to calculate the invariant latitude and determine whether the satellite is in sunlight or in darkness; (2) to plot electron current, satellite altitude, and the sun/shade data as a function of GMT time, local time, invariant latitude; and (3) to display various ephemeris and aspect parameters for particular orbits and for each RPA sensor.

TITLE: Analysis of Bistatic Radar Observations of CAT
AUTHOR: Dabcovich, M.

INITIATOR: Atlas, D. (LYW)
PROJECT: 6672 PROBLEM NO. 1130

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 20_8k

The general problem consists of analyzing bistatic radar observations of the CAT layer of the atmosphere, and finding the volume bounded by two conical-shaped radar pulses within that layer. CAT stands for Clear Air Turbulence and it was discovered that turbulent clear air, even though invisible to the eye, reflects radar frequencies. In the setup used, there is a transmitting and a receiving station. The transmitting station emits a signal of finite length that is reflected by the CAT layer and picked up by the receiving station. The amount of turbulence is defined by the strength of the reflected signal and, among other things, the volume from which the signal is reflected. Therefore, it is important to know this volume accurately. This volume is made up of two truncated cones and bounded by the upper and lower surfaces of the CAT layer. The centerlines of the cones are defined to be intersecting.

The computer program is a test of the value of the Monte-Carlo Method as applied to this type of problem. A simple monostatic case of the intersection of a radar beam and the CAT layer is evaluated analytically and by the Monte Carlo technique, and the results are compared.

TITLE: Generation of Solar and Lunar Ephemerides
AUTHOR: Hussey, I.

INITIATOR: Cronin, E. (SUYA)
PROJECT: 0001 PROBLEM NO. 1131

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 32_8k

The Solar and Lunar Ephemeris programs generate solar and lunar position data at prescribed time steps for any station location and any elevation angle between ±90°, with the option to specify these limits.

The solar ephemeris prints out, as a function of Universal Time (U.T.), the hour angles, azimuth, declination, and elevation.

The lunar ephemeris prints out the receiving and transmitting stations and, as a function of U.T., the local hour angle, declination, elevation, azimuth, libration rate, and the cycles/second of transmitting station(s).

A short version of both the solar and lunar ephemeris programs is available to print out, as a function of U.T., elevation angle (refracted and unrefracted) and azimuth only.

TITLE:	Analysis of Sacramento Peak Airglow Data
AUTHOR:	Grossman, P.
INITIATOR:	Hernandez, G. (LIR)
PROJECT:	7661 PROBLEM NO. 1132
HARDWARE/SOFTWARE:	IBM 7044/Fortran IV
MINIMUM CORE SIZE:	27_8k

Sacramento peak airglow data was analyzed. The airglow intensities (in Rayleighs) were tabulated by hours and minutes, one table for each date, in a form suitable for publication.

The daily arithmetic mean of the given airglow data was computed, and the results were listed.

Table look-ups and interpolations were performed also. A third-degree polynomial was fitted to each table, and the interpolations were taken from the polynomial curve.

In addition, a frequency count of the airglow data was produced over a specified period.

TITLE:	Reflectivity of Thin Films
AUTHOR:	Dolan, J.
INITIATOR:	Loewenstein, E. (OPI)
PROJECT:	7670 PROBLEM NO. 1133
HARDWARE/SOFTWARE:	IBM 7044/Fortran II
MINIMUM CORE SIZE:	20_8k

The energy throughput of an interferometer is calculated for the case where an unsupported thin film of Mylar is used as a beamsplitter. The polarization of the beam toward the detector is calculated, and it is shown that by setting the beamsplitter at the Brewster angle rather than at the usual 45°, a completely polarized output beam can be produced with very little loss of energy. Although the optical constants of Mylar are not well known, the theoretical and experimental results were in good agreement. Derivation of equations was possible.

TITLE: Calculation of Electron Flux and Counting Rate
AUTHOR: Delorey, D.

INITIATOR: Ulwick, J. (LIJ)
PROJECT: 7663 PROBLEM NO. 1134

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 115_8k

The electron counter, flown aboard rockets AJ17.758 and AJ17.617, was designed to measure electron flux for electrons having energies greater than 17 kev, 26 kev, 42 kev and 90 kev.

The instrument output is a commutated dc voltage with levels roughly proportional to the logarithm of the input count rate.

"ELCOUN" calculates the observed and true counting rate and electron flux for each of the threshold levels of the detector. Plots and listings of pitch angle, observed counting rate, true counting rate and electron flux are produced as functions of time with altitude noted for each of the four energy levels.

TITLE: Meteor Trail Data Reduction
AUTHOR: Grossman, P.

INITIATOR: Barnes, A. (LYU)
PROJECT: 8628 PROBLEM NO. 1135

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS; IBM 7044/Fortran IV, MAP
MINIMUM CORE SIZE: 23_8k

This task encompassed the reduction of meteor trail wind and density data. Calculations were made for Doppler, range, azimuth and elevation angle. Output consisted of a listing of trail wind information and digital plots.

TITLE:	Solar Spectral Irradiance Study by Least-Squares Curve-Fitting	
AUTHOR:	Dolan, J.	
INITIATOR:	Gast, P. (OPA)	
PROJECT:	7670	PROBLEM NO. 1136
HARDWARE/SOFTWARE:	IBM 7044/Fortran IV	
MINIMUM CORE SIZE:	34_8k	

Four programs perform least-squares curve-fitting and extrapolation as follows:

a. The program "RUP. GAST PLOT" plots three sets of data, the first as a line, and the last two as points.

b. "LOG PLOT" produces a Calcomp plot of a black-body temperature vs wavelength. The wavelength is represented as the x axis in $\log_{10}$.

c. Given the wavelength (WAVE 1) in microns and the black body temperature (BTEMP) in degrees Kelvin, "TEMP" finds a corresponding solar irradiance (RAD1).

d. Given the wavelength (WAVE 1) in microns and the solar spectral irradiance (RAD1), "BBTEMP" computes a corresponding black body temperature (BTEMP).

TITLE:	Theoretical Trajectory of Sounding Rocket	
AUTHOR:	Dabcovich, M.	
INITIATOR:	Hoult, C. (LCR)	
PROJECT:	5710	PROBLEM NO. 1137
HARDWARE/SOFTWARE:	IBM 7044/Fortran IV	
MINIMUM CORE SIZE:	51_8k	

This program was designed to produce theoretical trajectory information for a variety of sounding rocket configurations; in particular, four specific trajectories were requested. In order to approximate the trajectory model, it was first necessary to assume that the rocket was a point mass moving in a plane. This method of solution involved the integration of the equations of motion to obtain velocity and positions as a function of time. The equations of motion are given by Newton's laws, and the Freedom Sounding Rocket Trajectory was calculated for two degrees.

TITLE:	Electromagnetic Material Experime 'ation
AUTHOR:	Dolan, J.
INITIATOR:	Lipson, H. (LQO)
PROJECT:	5621 PROBLEM NO. 1138
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	30_8k

This task effort involved the data reduction of raw spectrometric data vs drum division of transmission, reflection or fluorescence spectra in ultraviolet, visible or infrared wavelengths. The reduced data is calibrated and corrected for instrument and detector response. The programs developed were designed to be used with data using increments of 0.5 of a drum division.

These programs reduce experimental data and produce plots (both Calcomp and printer graphic) by selection of parameter combinations. The input data is reduced by calibrating and correcting for instrument and detector response. The program uses card input as data on which there are five groups of intensities and drum divisions per card, and any number of cards per section. "TRANS," the first program, obtains its correction factors from input cards, whereas "5000Å," the second program, uses an equation to generate the correction factors, which correct the instrument readings to what they would be under ideal conditions.

TITLE:	AFCRL Research Library Data Processing	
AUTHOR:	Pollock, L.	
INITIATOR:	Cronin, E. (SUYA)	
PROJECT:	0001	PROBLEM NO. 1139
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV CDC 6600/Fortran IV	
MINIMUM CORE SIZE	50_8k	

A series of programs was written for the AFCRL Research Library (1) to facilitate a file maintenance system for the library's Master Serials File and (2) for performance of data processing for a Master Inventory File.

The first group of programs written for the DCS under Problem No. 1447 and converted to the CDC under this job effort is a maintenance system concerned with serial publications. The system includes such functions as sorting, editing, updating and listing of a master serials library file and a master active titles file. Some of the output created by the system includes: (1) an updated master serials file on magnetic tape, (2) a subscription order summary, (3) an "Errors and Comments" report, (4) listing of accounts containing Library of Congress call numbers and (5) ordered list of Class 3 Holdings (order-receipt) cards.

The second group of programs written for the DCS performs data processing to build a Master Inventory File upon which the Circulation System operates. This task is accomplished by using tapes from Inforonics, Inc. as a data base. Some of the tasks performed include: (1) selection of monographs from a created directory, (2) manipulation and updating of the Master Inventory File, (3) preparation of a Borrower's File providing a current listing of the borrowers and their numbers, and (4) preparation of a library circulation list of books showing the circulation history of each book.

TITLE:	Number Density of Atomic Oxygen	
AUTHOR:	Pustaver, J.	
INITIATOR:	Marcos, F. (LKB)	
PROJECT:	6690	PROBLEM NO. 1140
HARDWARE/SOFTWARE:	IBM 7044/Fortran IV	
MINIMUM CORE SIZE:	21_8k	

This problem is designed to calculate the theoretical density of atomic oxygen. Two functions of altitude are to be computed for a range of 80 km less than or equal to Z less than or equal to 120 km. Originally, ten sums were expected, assuming allowance for "constant" modifications. A special routine is used to bypass floating point traps. Different runs are possible using different boundary conditions, different constants and different values of diffusion coefficients.

TITLE: Light Scattering
AUTHOR: Grossman, P.

INITIATOR: Fenn, R. (OPA)
PROJECT: 7621 (OPA) PROBLEM NO. 1141

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 28_8k

Monte Carlo procedures were developed to study the transport of light through the earth's atmosphere under various environmental conditions. The methods used an air-ground geometry to treat the Rayleigh and Mie Scattering, and to treat ground and cloud reflection. "LITE II," a program originally written in Fortran II, is converted and utilized. It treats monochromatic plane sources of light through use of sufficient flexibility codes enabling treatment of multiple scattering in an atmosphere in which air density and aerosol size distribution vary independently and arbitrarily with altitude. Provisions for treating ground and cloud reflection with an albedo method are also available in the codes. These codes were verified through comparisons with other calculations of light transport in the atmosphere. This version includes the Albedo Conversion Code, "ACC," although it was not utilized in this research.

TITLE: Ionospheric Radio Transmission Quick-Look Program
AUTHOR: Dabcovich, M., and Dalton, L.

INITIATOR: Pittenger, E. (LII)
PROJECT: 5631 PROBLEM NO. 1142

HARDWARE/SOFTWARE: IBM 1460/Autocoder
MINIMUM CORE SIZE: 10_8k

Tapes containing ionospheric radio transmission data were recorded during airplane flights resulting in the generation of non-compatible Fortran tapes. Since a quick-look type output was immediately required, an IBM 1460 tape-to-printer program was written. This program was later modified to normalize the transmission values to correspond to plotter requirements. Output changes were made and flexible switch-controlled print and tape output were included. This program is conducive to large amounts of output with the least amount of computation. The tapes were converted into quasi-IBM format for use of Lowell Technological Institute.

Later, a complete series of programs was designed to facilitate the processing of the data tapes. They perform the following:

a. Produce error-free data tapes.
b. Block tapes with extra-long records.
c. List the input tapes for quick data analysis.
d. Retrieve, unpack, convert and process the ionospheric data.
e. Generate plots of the medians and upper and lower quartiles for each frequency.

TITLE: Spacing of Antenna Elements
AUTHOR: Small, E.

INITIATOR: Drane, C. (LZR)
PROJECT: 4600 PROBLEM NO. 1143

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 10_8k

The problem concerns the investigation of a nonlinear system of equations. The work is divided into three parts concerned with values in a pair of matrices from an eigenvalue program supplied by the initiator. The first part assumes uniform spacing elements; the second solves both uniform and nonuniform spacing problems; the third uses an iterative method to determine the optimal spacing based on an initial estimate. From the solution, it is desired to determine the spacing of antenna elements and tne waveform associated with that antenna.

Two functions developed for these programs include ARCOSH(X) and ARSINH(X), which are supplied as arithmetic statement functions and as independent function-type subroutines. They are intended for additional general use.

TITLE: Wind Speed Determination
AUTHOR: Hoffman, R.

INITIATOR: Nee, P. (LKI)
PROJECT: 3624 PROBLEM NO. 1144

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 75_8k

The work analysis required reduction of radar tracking coordinates of a falling sphere of high altitude wind profiles. Values of velocity and acceleration for all three (X,Y,Z) coordinates were calculated and the wind in the X and Y direction was computed. Plotted was the wind in the X vs Y direction and the X vs Y velocities. All operations could be performed on data from multi-file binary tapes, including determination of exactly what data segments existed on one particular tape. Options were included to use different segments from one or many flights. The width of the central moving average smoothing function was varied to determine the effect on the wind data. All work was accomplished by modifying an original program three times. Final tabular output included time, altitude, descent velocity, vertical acceleration, and X and Y velocities, winds and accelerations.

TITLE: Ionospheric Index of Refraction
AUTHOR: Small, E.

INITIATOR: Sheehan, L. (OPA)
PROJECT: 4662 PROBLEM NO. 1145

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 6_8k

A complex expression evaluation was programmed to analyze the index of refraction in the ionosphere using the Appleton-Hartree equation. The program computes the equation which includes a complex variable resulting in positive and negative solutions. Two cases are of concern and output includes tables and plots of the real and imaginary parts separately.

TITLE: Gas and Temperature Analysis in a Shock Tube
AUTHOR: Hoffman, R.

INITIATOR: Kelley, J. (PHE)
PROJECT: 8608 PROBLEM NO. 1146

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 24_8k

Analysis of conditions in a shock tube was done as a function of two parameters, gas mixture ratio and temperature. The program was designed for computation of various conditions over four regions of temperature and gas variation. Programming problems involved the range of numbers and the solution of fourth and fifth-order algebraic polynomials. To circumvent the problems arising from the large range of some of the variables it was necessary to use the system routine "FPT" to ignore floating-point underflows and overflows. The roots of the algebraic polynomials were found using a special subroutine, "DBIRGV," which solves for the roots using the Birge-Vieta technique, with intermediate computation done in double precision to minimize truncation effects.

TITLE: Bulk Wave Velocity
AUTHOR: Conway, E.

INITIATOR: Yorsz, W. (LZM)
PROJECT: 5635 PROBLEM NO. 1147

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 56_8k

This program computes the bulk wave velocity and other parameters for different orientations at the crystal axes with respect to the crystal surfaces. Bulk waves prove useful in the design of delay lines for use in signal processing devices for two reasons: (1) they have higher frequencies (that is, wider bandwidths) than surface waves and (2) they allow longer delays than surface waves. The program may be modified to handle piezoelectric as well as nonpiezoelectric crystals.

For each degree there are three sets of data, each set consisting of output values for Euler angles, a computed velocity, and stress, strain, and power flow values. Punched output consists of a card for each degree of Euler angle "HUB," velocity one and associated power angles, velocity two with power angles, and velocity three with power angles. In addition, velocities, power angles and strain values are plotted.

TITLE: X-Ray Power Spectra Correction
AUTHOR: O'Brien, J.

INITIATOR: Bradford, J. (LQR)
PROJECT: 5710 PROBLEM NO. 1148

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 50_8k

"DISTORT" corrects x-ray power spectra for the effects of photo-tube and scintillation crystal distortion. Analysis is based on the following:

If a beam of x-rays is impinging on a scintillation crystal, then the scintillations of the crystal are picked up by a photo-multiplier, and the output of the phototube is fed into a pulse height analyzer. The output of the pulse height analyzer is a pulse height distribution over energy. From the pulse height distribution, it is therefore possible to determine the power spectrum (radiation intensity vs photon energy) of the incoming x-rays. Any distortion introduced by both the scintillation crystal and the phototube cause the pulse height distribution to be different from the x-ray power spectrum. However, if the characteristics of both scintillation crystal and phototube are known, the x-ray power spectrum can be determined from the pulse height distribution by a process of unfolding. This program incorporates such a method to correct the x-ray power spectra for distortion effects. The characteristic of the photo-multiplier is specified by a Gaussian response matrix.

TITLE:	Spectral Density Measurements - Auroral Storm
AUTHOR:	Grossbard, N.
INITIATOR:	Hall, W. (LKA)
PROJECT:	7661 PROBLEM NO. 1149
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV, MAP
MINIMUM CORE SIZE:	36_8k

A great aurora was observed at Bedford, Massachusetts, on March 23 and 24, 1969. During the later phases of the aurora, the 5577A emission was observed to have periodic pulsations. A spectral density analysis of these measurements was performed in order to provide an experimental measurement upon which theoretical models of auroral substorms can be extended to low latitudes.

A mathematical filter was developed to fit the frequency response curve in a near least-square sense and the numerical filter was applied to the data to form a filtered result. A Fast Fourier Transform was used to find the Fourier power spectrum, which was plotted on the CRT.

TITLE:	High Altitude Rocket Trajectories
AUTHOR:	Robinson, E.
INITIATOR:	Hutchinson, R. (PHG)
PROJECT:	7601 PROBLEM NO. 1150
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	77_8k

"TRAJ-2" of Problem No. 1236 is applied to compute the position data for rockets AC19.289 and AF19.291.

Rocket trajectories were generated from Fort Churchill, Canada, radar data. "TRAJ-2" was used because of the length of the rocket flights. The flights lasted approximately 900 sec and reached peak altitudes of approximately 800 km. Specific segments of the raw data were selected to achieve the optimum trajectory.

TITLE:	Total Electron Current Plots
AUTHOR:	Conway, E.
INITIATOR:	Klobuchar, J. (LIR)
PROJECT:	4643 PROBLEM NO. 1151
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	4[illegible]$_8$k

This program plots total electron current readings, recorded every 15 minutes, vs local mean time. Daily, monthly, or offset monthly plots may be an optional output, along with printed output consisting of one day of data at 15-min intervals per page. The data values for day, month and year are labelled for 0 through 23 hours.

TITLE:	Aspect Disturbances
AUTHOR:	Small, E.
INITIATOR:	Lorentzen, A. (LII)
PROJECT:	4691 PROBLEM NO. 1152
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV, MAP
MINIMUM CORE SIZE:	31_8k

A Fourier analysis of frequency and power data is performed for a vehicle aspect disturbance study. The main program computes and prints frequency and power from the coefficients computed by subroutine FOURIER, which computes the Fourier coefficients of the data array. A reverse bits subroutine is used in computation.

TITLE:	Plot Subroutines
AUTHOR:	Hornik, G.
INITIATOR:	Ross, H. (PHL)
PROJECT:	8602 PROBLEM NO. 1153
HARDWARE/SOFTWARE:	IBM 7044/Fortran IV
MINIMUM CORE SIZE:	20_8k

This work effort involved conversion of several plot subroutines to Fortran IV. The routines included the following:

PLOTIT gives a quick plot on an array of data and in turn calls EDITIA which is used to edit integers to alphameric data. SCALE and GRAPH obtain quick plots with the normal printed output. More specifically, SCALE will set the scaling for various curves to be plotted, and GRAPH will insert a character into the proper Y position on the line. The program was designed for the purpose of packing a tape for the CALCOMP plotter.

TITLE: Airborne Gravity Flight-Vertical Acceleration Study
AUTHOR: Hornik, G.

INITIATOR: Anthony, D. (LW)
PROJECT: 7600 PROBLEM NO. 1154

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 60_8k

This Research involved the periodic nature of vertical accelerations experienced on airborne gravity flights. The average acceleration measured in the vertical direction over an arbitrary time interval will usually contain a component due to the vertical acceleration resulting from aircraft motion. Denoting the gravity and vertical acceleration experienced at any one instant as g and $\ddot{z}$, the result of averaging over a time interval t is g^1. The gravity we measure (g^1) will differ from the true gravity (g) by some quantity which is zero over many segments of the data interval and, in particular, will be zero between any maximum/minimum points of the elevation trace.

This program finds polynomial fits to the given elevation data and computes the average acceleration of the fitting polynomial in order to compute an estimate of the average acceleration of the data.

The method is to fit a least-square polynomial to 11 elevation points spaced 3 sec in time apart (11 points for a 30-sec interval, counting both ends). The data is fit separately by polynomials of degree 2 through 9 (8 through 1 deg of freedom).

To solve the least-squares system of equations, a subroutine called "IDSIMQ" is used. This subroutine was taken from the book, Mathematical Methods for Digital Computers, by A. Ralston and A.S. Wilf.

TITLE:	Paper Tape Antenna Control	
AUTHOR:	Grossbard, N.	
INITIATOR:	Kalaghan, P. (LZN)	
PROJECT:	8682	PROBLEM NO. 1155
HARDWARE/SOFTWARE:	IBM 7044/Fortran IV	
MINIMUM CORE SIZE:	50_8k	

Data is taken from an ephemeris table and transformed into elevation and azimuth positions at the radio telescope. The program also finds their derivatives vs time, and these values are put into the system of units used by the radio telescope "computer." There are four ways in which a moving body can be tracked by this program:

a. NCONT=2 read in a series of declination increments and azimuth increments. Run NNN cycles using these series of values. These values determine how much off the center of the object (as determined by the ephemeris tables) the telescope should point (Units = normal increments used throughout this program).

b. NCONT=1 stay at the center of the object NNN counts.

c. NCONT=-1, involves 17 tracks where, during 5-min intervals, the antenna is placed off the body so as to allow the body to drift through the antenna (the antenna is held fixed).

d. NCONT≠2 or 1 or -1 tracks from the center and then out and circularly around. A racket is formed over the entire body with 17 movements of the elevation.

TITLE:	Paper Tape Read (CDC 6600)	
AUTHOR:	Reinhold, A.	
INITIATOR:	Smart, D. (PHE)	
PROJECT:	000D	PROBLEM NO. 1156
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV	
MINIMUM CORE SIZE:	14_8k	

A utility program was written to read ASCII paper tapes and convert the ASCII character code to CDC 6600 display code. Paper tapes must conform to CDC input standards, and it is possible to read more than one length of paper tape during program operation. This program can easily be modified for special applications involving paper tapes. Output records consist of 80 characters, and the medium can be any SCOPE file, that is, magnetic tape, punch cards, printer or disk file.

TITLE: Distribution of Scintillation Indices
AUTHOR: Hoffman, R.

INITIATOR: Allen, R. (LIR)
PROJECT: 4643 PROBLEM NO. 1157

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 17_8k

Statistical analysis of scintillation data from Transit 4A from July 1961 to December 1963 was done with special consideration to the time interval between successive Faraday nulls using the Type I data. The data received was composed of a file of 30,000 cards which included two different types of data cards interspersed with summary cards and bad data, which included duplicates and invalid cards. Before statistical analysis was possible, it was necessary to write a series of three programs to "clean-up" the file in order to sort desired good data from erroneous and undesired data. The resulting files containing Type I 400 km data and Type II 250 km data were used as input for statistical analysis.

TITLE: Least-Square Fit to Non-Linear Equation
AUTHOR: Mazzio, V.

INITIATOR: Tsipouras, P. (SUYA)
PROJECT: 0001 PROBLEM NO. 1158

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 30_8k

"GAUSP" makes a least-square fit to a non-linear function by using the gradient-expansion algorithm given by Donald W. Marguardt, in "An Algorithm for Least-Squares Estimation of Non-Linear Parameters," J. Soc. Ind. Appl. Math. 2(No. 2): 431-441, June, 1963. A gradient search is combined with an analytic solution developed from linearizing the fitting function. Four subroutines and function subprograms required are as follows:

- FUNCTN - Evaluates the fitting function for the Ith term.
- FCHISQ - Evaluates the reduced CHI square for fit to the data.
- FDERIV - Evaluates the derivatives of the fitting function.
- MATINV - Inverts a symmetric two-dimensional matrix of degree N terms and calculates its determinant.

TITLE:	Rocket A07.907-1 Charged Particle and Photometer Data Reduction	
AUTHOR:	Fusco, J.	
INITIATOR:	Smiddy, R. (LIF)	
PROJECT:	8617	PROBLEM NO. 1159
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV	
MINIMUM CORE SIZE:	134_8k	

Charged particle and photometric data from Rocket No. A07.907-1 is reduced by three programs.

1. The time, elapsed time, altitude and the 31 data pins for the entire launch are listed, and a plot of data pin 16 vs time is output.

2. Approximately 250 CRT plots of the Niro rocket launch sweep data are created.

3. Calcomp plots of data pin 8 vs elapsed time, ascending altitude and descending altitude for modes 0, 1, 2 and 3 and Calcomp plots of the odd data pins for each sweep are created.

TITLE:	Fixed Threshold Decoding Probabilities	
AUTHOR:	Pustaver, J.	
INITIATOR:	Hobbs, C. (LRD)	
PROJECT:	4610	PROBLEM NO. 1160
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	25_8k	

This program calculates the probability of events connected with the decoding of binary coded words by a decoder which filters each signal, treats ambiguous signals as blanks and attempts to fill in the blanks by checking a set of parity check equations for even parity. If all blanks are filled in and all parities check, the word is accepted.

The probabilities to be calculated are as follows:

P_1 = Probability of correct decoding

P_2 = Probability of rejection due to detection of blanks

P_3 = Probability of rejection due to detection of errors

P_4 = Probability of one or more errors and acceptance by decoder.

The probabilities are calculated by two methods, one involving the Gaussian channel and the other involving Rayleigh fading.

TITLE: Measurement of Atmospheric Aerosol Properties
AUTHOR: Harris, S.

INITIATOR: Elterman, L. (OPA)
PROJECT: 7670 PROBLEM NO. 1161

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 30_8k

A knowledge of atmospheric aerosol properties is necessary for the solution of many research and applied problems. Transmission, visibility, astronomical seeing, meteorological tracing and turbulence are a few important examples. In nearly all of the problems concerned with the interaction of light with the atmosphere, the aerosol attenuation coefficient in the troposphere and stratosphere emerges as an indispensable and little-known parameter. The purpose of the investigation supported by this programming effort was to determine quantitatively the coefficient and related parameters using the searchlight technique.

Three programs are used to measure the atmospheric aerosol properties by the technique of searchlight probing. "AERPLT" produces Calcomp plots of atmospheric searchlight probing response vs altitude. "AERSOL" adjusts the raw data in accord with experimenter commands and generates a straight-line fit to four data points. "HIDATA" scans high altitude data profiles for cards out of order. The original and normalized response values and a Calcomp plot for each profile are output.

TITLE: Atmospheric Variability Analysis
AUTHOR: Kellaher, J.

INITIATOR: Nee, P. (LKI)
PROJECT: 8624 PROBLEM NO. 1162

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 30_8k

An atmospheric variability analysis was performed through a computer program which computes the root mean square change in height of various pressure levels for time and space intervals. Data consisting of the station, date and release time for each sounding is used as input. The program series does the following: (1) produces a tape table of contents, (2) produces a reduced content tape of mandatory level data with transfer soundings, and (3) computes the RMS change in height for all the pressure surfaces.

TITLE: OSO Vehicle Data Reduction and Analysis
AUTHOR: Vicksell, F.

INITIATOR: Hall, A. (LKO)
PROJECT: 6688 PROBLEM NO. 1163

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS; CDC 6600/Fortran IV
MINIMUM CORE SIZE: 70_8k

This project was undertaken to study solar emissions and to determine high-altitude earth-atmosphere composition and temperature.

Several programs were written to process extreme solar ultraviolet observations from the OSO-III satellite. The telemetered data from the satellite is reproduced in a variety of printed and plotted formats and is combined with orbital information. Atmospheric optical depths and scale heights are estimated for various wavelengths at different latitudes, longitudes and at different seasons of the year.

In addition, theoretical optical depths are calculated and plotted by performing the necessary calculations on models of the atmosphere. These theoretical values are compared with the values obtained through approximation methods. Either rocket or satellite observations can be simulated.

TITLE: OV3-1 Data Reduction and Analysis
AUTHOR: Dalton, L.

INITIATOR: Smart, D. (PHE)
PROJECT: 8600 PROBLEM NO. 1164

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV, FAP
MINIMUM CORE SIZE: 11_8k

The program "OV3 DATA RED" was written to provide quick-look capability for analysis of telemetry data from the OV3-1 vehicle. This program retrieves real-time and playback commutator data and converts the data to volts and time. The data format is variable. The program is general in concept and has many options and capabilities.

TITLE: Solution of an Integral Equation
AUTHOR: Tsipouras, P.

INITIATOR: Yates, G. (PHE)
PROJECT: 8600 PROBLEM NO. 1165

HARDWARE/SOFTWARE: Not Applicable
MINIMUM CORE SIZE: Not Applicable

Mathematical analysis was done to assist in the investigation for the solution of an integral equation of the convolution type. The integral equation was expressed as follows:

$$N(t) = \int_{-\infty}^{\infty} s(t-t') \, I(t') \, dt'$$

where the unknown function is taken to be $s(t-t')$, and the function $I(t')$ is assumed to be a Gaussian. In this analysis $N(t)$ and $I(t)$ are assumed to be given at discrete points (finite), but where $I(t)$ takes the form of a Gaussian Function.

The system derived is in a tailored form expressed by a polynomial approximation. It could be solved numerically by any one of a number of existing matrix-solving Fortran subroutines.

TITLE: Evaluation of Hilbert Transforms
AUTHOR: Tsipouras, P.

INITIATOR: Thomson, K. (LWW)
PROJECT: 7639 PROBLEM NO. 1166

HARDWARE/SOFTWARE: Not Applicable
MINIMUM CORE SIZE: Not Applicable

The nature of the problem is purely mathematical and involves the integration evaluation of Hilbert transforms:

$$E_2(w) = \frac{2w}{\pi} \int_{0}^{\infty} \frac{E_1(x)dx}{x^2-w^2} .$$

The function $E_1(x)$ is continuous and chosen in such a way as to make the above integral convergent. The integral has a singularity at the point $x = w$ of the x-axis.

Two methods have been derived to evaluate $E_2(w)$. The first was the Residue Theorem, and the second is an approximation method.

TITLE: Analysis of Equipotential Lines of an Electric Field
AUTHOR: Grossbard, N.

INITIATOR: Jasperse, J. (LQR)
PROJECT: 5621 PROBLEM NO. 1167

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS, CDC 6600/Fortran IV
MINIMUM CORE SIZE: 70_8k

The equipotential lines are found for a function representing the electric potential of a hemisphere with a potential ring in its base. It is usually helpful to know the electrostatic potential as a function of the spatial variables and applied voltage in an electronic device. Knowledge of the potential function is important for the optimum design of field effect transistors, electron multipliers, LEED apparatus, electron microscopes, retarding potential analyzers and many other apparatus. While experimentally studying the emission of electrons from metals caused by bombardment of high energy radiation, a hemispherical geometry was discovered that can be used for an electron retarding analyzer. This geometry has the advantage that no material body, such as a grid, is placed between the electron emitter and the collector. The electrostatic potential can be calculated anywhere in the hemispherical volume using the Green's function method.

The Dirichlet Green's solution for the electrostatic potential inside a hemisphere is determined by the calculation of the potential function for cases with azimuthal symmetry in internal charge distribution and surface potential. When the electrode potentials and the internal charge density are known, the solutions given could be used to optimize the design of electrostatic field effect devices in this geometry.

Both the original DCS version and the CDC version of this program have been retained and are available for use. Both versions output printing and punched cards and produce drum plots of the electrostatic potential.

TITLE: Sorting and Merging of Snapshot Satellite Data
AUTHOR: Lemone, K.

INITIATOR: Ulwick, J. (LIJ)
PROJECT: 7663 PROBLEM NO. 1168

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 30_8k

Three programs sort, merge and reformat data from the snapshot satellite with orbit information on the ephemeris tape.

MERGESNAP-5 merges seven separate files, each containing a list of times with an associated data value, into one file, which consists of a list of times followed by five data pins.

SUPERMERGE merges seven pins on the data tape with orbit information (altitude, longitude, etc.) on the ephemeris tape.

COPY-BACK reverses the groups within a file; that is, the last group becomes the first, the next to the last becomes the second, etc. Also, options were written to allow files to be skipped or copied as they are.

TITLE: Digitize and Rescale Curve
AUTHOR: Grossman, P.

INITIATOR: Manson, J. (LKO)
PROJECT: 6688 PROBLEM NO. 1169

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 30_8k

The problem was to digitize a curve and replot it at a different scale. The abscissa was annotated in terms of wavelength, that is, varying sinusoidal with distance. The original curve was digitized 20 points to an inch. The Y-axis was digitized 100 counts per in. with the base line taken to be the same as that of the original curve. The Y scale of the original curve was 1000 counts per 141/32 in. The program produces a tape for the Calcomp plotter, which will then plot the curve at the desired scaling. The proper wavelengths are determined and printed along the X-axis. The counts per second are printed along the Y-axis. Certain calibration wavelengths are also indicated along the top of the paper. Eleven-inch paper must be requested for plotting.

TITLE: Conversion of Raw Tapes
AUTHOR: Savage, K.

INITIATOR: McInerney, R. (SUYA)
PROJECT: 0001 PROBLEM NO. 1170

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 60_8k

Raw data tapes generated at Northeastern University for the IBM 7094 computer were converted to CDC 6600 compatible tapes by this job effort. The purpose of Program "CVTNE" was to convert each data record containing IBM 36-bit words to a comparable data record containing 60-bit words to enable processing by the CDC 6600 system. The 36-bit word was converted as either of the following: (1) A 36-bit integer was converted to 60 bits as 36 bits right-justified with zero fill; (2) a 36-bit floating point number was converted to a comparable CDC floating point number. Any number of files can be converted and the time words can be unpacked and converted to total seconds.

TITLE: Rocket A07.902-2 Aspect Calculation
AUTHOR: Fioretti, P

INITIATOR: Narcisi, R. (LKD)
PROJECT: 6687 PROBLEM NO. 1171

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 40_8k

"RASP" is part of an operating system to calculate rocket aspect from gyroscopic data transmitted during flight. The corrected pitch and gyroscopic data from rocket no. A07.902-2 is input to "RASP," which calculates the azimuth, elevation and angle of attack of the rocket aspect. Altitude and magnetic field data are calculated as a function of time and output with the angle of attack between the longitudinal axis of the rocket and the velocity and magnetic field vector.

TITLE: Distances and Azimuths for Points on an Ellipsoid
AUTHOR: Pustaver, J.

INITIATOR: Anthony, D. (LWH)
PROJECT: 7600 PROBLEM NO. 1172

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 21_8k

The purpose of the work done was to calculate the forward azimuth, reverse azimuth and mutual distance of two given points on an ellipsoid. Robbin's formula was used to compute the forward azimuth and distance for the computation of the reverse azimuth. Cunningham's formula was used in place of the equations in Robbin's formula to avoid excessive round-off error encountered on the computer when performing this computation by use of Robbin's formula. The program is also designed to calculate the speed in knots when a time of travel between two points is given. Formulae were taken from Bomford's Geodesy, pp 108-109, Oxford University Press, 1962. The printed output was in tabular form, with azimuth in decimal degrees and also degrees, minutes and seconds; distance in meters; and velocity in knots.

Robbin's formula was correct to 1 in 10^8 at 1600 km when using 9-place tables. This was the accuracy that could be expected from single precision. When double precision was used, results showed a difference of 5 in 10^9.

TITLE: Solar Altitude Determination
AUTHOR: Patterson, J.

INITIATOR: Bertoni, E. (LKI)
PROJECT: 8624 PROBLEM NO. 1173

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 40_8k

Solar altitude is to be computed for a given location every hour on the half-hour from 330 to 2130, on the 15th day of every month. Input includes latitude and longitude of observer, time zone of observer, an "equation of time," an auxiliary quantity related to time, and the angle of declination of the sun. The parameters include the number of months, the number of locations, the beginning time and the final time. The output is a table of solar altitudes.

TITLE:	Digitized Tape Data Unpack and Processing
AUTHOR:	Fusco, J.
INITIATOR:	Ames, L. (LZN)
PROJECT:	8682 PROBLEM NO. 1174
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV, MAP
MINIMUM CORE SIZE:	45_8k

Two programs process a digitized tape.

"TTALLY" unpacks the time pulse channel, lists the timing pulse and flags all errors in the timing sequence. The input control cards allow for the processing of any number of tapes and a variable number of files on any tape. Output consists of printed time pulse channels, 80 per line, and any errors in the timing sequence.

"MPRINT" demultiplexes each word on the tape, and lists all data for the five channels. A number of options provides for printing of selected records in selected files for any number of files.

TITLE:	Moving Average General Program
AUTHOR:	Birtwell, R.
INITIATOR:	Lenhard, R. (LKI)
PROJECT:	000D PROBLEM NO. 1175
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	40_8k

Data on a Fortran BCD tape was smoothed by the method of moving averages. This method requires that the mean of the values of the variable, for all points within a specified range above and below the point being smoothed, be substituted for the value at the point. In this particular case, the points included in the averaging were those which fell within 2500 meters above and below the point being smoothed. Two variables, U and V, are to be smoothed, and graphs of the smoothed values and their deviations from the original values are to be plotted. The smoothing was done for all points falling within 30 to 60 kilometers.

The spacing of the points was based on a unit of time rather than altitude. Therefore, the number of points within 2500 meters above or 2500 meters below the point being smoothed was a variable number. Altitude was descending.

Three programs were written. The first prepares the data tapes for input to the second, which smooths wind components for each flight. The third program plots all the data.

TITLE:	Solar Eclipse Beat Frequency Experiment	
AUTHOR:	Dabcovich, M.	
INITIATOR:	Gassman, G. (LIB)	
PROJECT:	5631	PROBLEM NO. 1176
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	70_8k	

The purpose of this program was to analyze digital data representing a periodic function by Fourier analysis to obtain a frequency spectrum. Input data is in BCD, with one record (that is, one block) containing 2400 IBM words. The maximum number of records to be analyzed will not exceed 100. Each record is analyzed separately to obtain its frequency spectrum. Output data for each record was plots of amplitude vs frequency in tabulated form. The expected frequencies lie between 39 and 41 cycles per sec, so that the program may be instructed to ignore Fourier components outside this range. Frequency resolution should be of the order of .016 cycles per sec. The program reads a set of altitudes and then performs the operations for the requested heights.

TITLE:	Linear Interpolation - General	
AUTHOR:	Patterson, J.	
INITIATOR:	Carroll, P. (LKS)	
PROJECT:	8627	PROBLEM NO. 1177
HARDWARE/SOFTWARE:	IBM 7044/Fortran IV	
MINIMUM CORE SIZE:	40_8k	

This program was developed to provide a least-squares curve-fit for a polynomial degree less than six. The problem was to fit a quadratic to a number of data points, and then compute preducted Y-values for given X-values, where $Y = A + Bx + Cx^2$. Each X-value must be read in with a label for identification. The coefficients of the quadratic are computed by the least-squares method, and all computations are done in double precision. Alternatively, an equation of the form $Y = A + Bx$ may be solved. The first card determines which computation is desired.

TITLE: Analysis of Radar Signals
AUTHOR: Grossman, P.

INITIATOR: Miller, J. (LYW)
PROJECT: 4610 PROBLEM NO. 1178

HARDWARE/SOFTWARE: IBM 7044/Fortran IV, MAP
MINIMUM CORE SIZE: 52_8k

An analysis of radar signals is done by processing two data tapes and producing power spectra. The data tapes are deblocked by a MAP routine, which extracts the data required for processing. A general-purpose plot routine was developed for quick results by producing a variety of printed plots with options, such as, bar graph, star graph, normalization between YMIN and YMAX, decibel scale, several other normalizations and octal, fixed-point or floating-point formats and conversions. The mathematical subroutine performs an auto-correlation and power spectrum analysis as delineated by R.W. Southworth in the book, Mathematical Methods for Digital Computers, by Ralston and Wilf, pp 213-220.

TITLE: Error Correcting Codes, Probability Computations
AUTHOR: Pustaver, J.

INITIATOR: Hobbs, C. (LRD)
PROJECT: 4610 PROBLEM NO. 1179

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 23_8k

Probability computations related to error correcting codes are analyzed by three programs which perform the following:

Part I calculates some probabilities for the equivalent uncoded block error associated with the decoding of an (n, k) code word, where n is the number of bits in the code word, and k is the number of information bits.

Part II finds the maximum likelihood for decoding block error probabilities.

Part III calculates an upper bound and lower bound for the probabilities of Problem B.

TITLE: Power Spectral Analysis of Meteor Trail Wind Data
AUTHOR: Grossbard, N.

INITIATOR: Barnes, A. (LYU)
PROJECT: 8628 PROBLEM NO. 1180

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS; CDC 6600/Fortran IV, MAP
MINIMUM CORE SIZE: 120_8k

Radar meteor trail wind data is not obtained at regular time intervals, and therefore, does not lend itself to power spectrum analysis in an easy, straight-forward manner. A method of obtaining the power spectrum was formulated, and several programs were written to implement it.

The task is divided into four parts as follows:

Part I separates solar, lunar and sidereal periods from radar meteor trail wind data and tests for significance.

Part II obtains a two-dimensional auto-correlation function (height and time) to be used for interpolation and smoothing of the data for ultimate use in two-dimensional spectral analysis.

Part III involves the use of two approaches in the study of moving synoptic weather systems. The first method is to remove the high frequencies (one day or less) and look at the remainder. The second method is to remove the significant periods (frequencies) found in Part I above.

Part IV involves a program capable of following with time the power and phase of one particular frequency.

The programs were written for the DCS originally, but several have been converted to the CDC 6600.

TITLE: Horizontal Spatial Correlations of Temperature
AUTHOR: Armstrong, D.

INITIATOR: Gringorten, I. (LKI)
PROJECT: 8624 PROBLEM NO. 1181

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV, MAP
MINIMUM CORE SIZE: 43_8k

Data archives are such that, for a selected cruising level, a reasonably large sample of daily average temperatures along a specific route can be obtained and summarized into a frequency distribution. But if, as in Air Force operations, many different and constantly changing routes are involved, then the climatological tools and methods must be such as to provide estimates of the route average temperature without recourse to the archives and the processing of raw data. A method has been devised that utilizes a model of the horizontal spatial correlations of temperature. It had been demonstrated on continent-wide area, and shows promise of hemisphere-wide application.

"The Horizontal Spatial Correlations of Temperature" program provides an empirical solution to temperature data when examined in accordance with the stations from which the data was obtained. The program was written to handle data from 66 stations, at various seasons and millibar levels. All of the data available has been run and analyzed and any future recordings might entail program modifications.

TITLE: Data Reduction-Solar Flux Observations
AUTHOR: Patterson, J.

INITIATOR: Barron, W. (LIR)
PROJECT: 4643 PROBLEM NO. 1182

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 50_8k

The problem concerned performing a variety of operations on several sets of solar radio observations. There are (1) distinctive event cards, and (2) single-valued flux cards.

Each distinctive event card contains all pertinent information about a single observation. Each single-valued card contains observations at five frequencies for a given day. Flux values at a given frequency are plotted with respect to time; and, if these values seemed to show some periodicity, an autocorrelation was carried out at each frequency for given lags.

TITLE:	Analysis of Real and Complex Fourier Transforms	
AUTHOR:	Friedman, M.	
INITIATOR:	Tsipouras, P. (SUYA)	
PROJECT:	000D	PROBLEM NO. 1183
HARDWARE/SOFTWARE:	Not Applicable	
MINIMUM CORE SIZE:	Not Applicable	

This problem consisted of mathematical research involved with the comparison of real and complex Fourier transforms over discrete equally-spaced intervals. A set of hourly measurements recorded over a long period of time with some gaps was supplied for the analysis. Interpolation between data points was used to construct a missing time data; however, this eliminated harmonic analysis of the data since gaps among the equally-spaced data cause difficulties.

Therefore, the Fourier coefficients were determined from the given data in order to perform interpolation without introducing extraneous harmonics into the data. Fast-Fourier transform techniques were also used.

TITLE:	OV3-1 Telemetry Data Merge	
AUTHOR:	Dalton, L.	
INITIATOR:	Sagalyn, R. (LIF)	
PROJECT:	8617	PROBLEM NO. 1184
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV, FAP	
MINIMUM CORE SIZE:	40_8k	

The OV3-1 Merge program was designed to merge OV3-1 telemetry data from the 120 segment commutator of the OV3-1 vehicle with the corresponding ephemeris data.

The program converts the commutator data from counts to volts and merges this data with the interpolated ephemeris data. A maximum of two playback orbits can be processed in one computer run or real-time orbits may be processed.

Options are available to process corrections to adjust for timing errors on the input telemetry tape.

TITLE: Analysis of Photographic Measurements
AUTHOR: Atkinson, J.

INITIATOR: Volz, F. (OPA)
PROJECT: 7621 PROBLEM NO. 1185

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 35_8k

In the course of atmospheric optics research, photographic twilight measurements for investigations of variations of stratospheric aerosol have been made at several stations. Several films, each with about 80 exposures (simultaneously in two wavelength ranges), had to be evaluated. Initially these calculations were done tediously by hand. To ease the workload, a computer program was written to perform all the necessary calculations.

The program was designed to compute the solar elevation from local time and to convert film densities to intensities, taking care of corrections for neutral filter steps, aperture settings and exposure duration. Since the input to the program was given in terms of the transmission percentage, it was necessary to convert this to film density. Statistical analysis was done on the photographic measurements for red and green filter ranges. A plot routine enabled the plotting of intensity and color ratio vs solar elevation, resulting in a more detailed study of the films than was earlier possible.

TITLE: Ionogram Data Processing
AUTHOR: Chin, J.

INITIATOR: Buchau, J. (LIB)
PROJECT: 5631 PROBLEM NO. 1186

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 20_8k

There is a need for the development of techniques that allow the specifying of the conditions of the ionosphere in real time over large parts of the globe. Therefore, program "IONOGRAM" was written to handle the digital ionograms produced with the Digital Sounder, Digisonde 128. It allows the printout of ionograms in a variety of formats, extracts certain parameters acceptable by the Digicoder-Xerox Printer combination, the main feature of which is pattern enhancement by weighted characters. (The surface of the printed numbers increases linearly with the increase in number value.)

TITLE:	Maximum of a Given Function of Multi-Value Parameters	
AUTHOR:	Small, E.	
INITIATOR:	Toman, K. (LII)	
PROJECT:	5631	PROBLEM NO. 1187
HARDWARE/SOFTWARE:	IBM 7044/Fortran IV	
MINIMUM CORE SIZE:	45_8k	

This program will compute the given Function F(Δ) and find the maxima points for various values of the given parameters.

There are four cases. Each case differs in the value of RM/RE. For each case 6 F(Δ)'s are computed for the 6 given Betas with delta varying from 0° - 180° in steps of 1 degree. At the end of each case the program gives the position of the Maximum F (Δ) in each case.

TITLE:	Total Electron Content Data Handling	
AUTHOR:	Dabcovich, M.	
INITIATOR:	Klobuchar, J. (LIR)	
PROJECT:	4643	PROBLEM NO. 1188
HARDWARE/SOFTWARE:	IBM 1401/1460/Symbolic Programming System II IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	10_8k	

Observational data contained on paper tape is transferred to punched cards, which are then reformatted.

"PCAR," an IBM 1401/1460 program written in Symbolic Programming System II language, inputs an 8-channel paper tape, and outputs punched cards in sets of 19 cards each. Each set contains a card with the year, month and day; electron content data cards; slab thickness cards; and blank cards separating the three types.

The punched cards are input to a DCS program "KLOBU," which reformats them so that there are eight electron data cards per case, with dates and twelve equally-spaced data points on each; and two slab thickness cards per case, with dates, and twenty-four equally-spaced data points on each.

Both programs produce listings of the data cards that are output.

TITLE: Solution of Electron-Ion Rate Equations
AUTHOR: Patterson, J.

INITIATOR: Sales, G. (LII)
PROJECT: 5631 PROBLEM NO. 1189

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 77_8k

Two electron-ion rate equations were solved numerically in order to obtain the variation of electron density, negative ion density and positive ion density as functions of time at various altitudes in the atmosphere. The two nonlinear ordinary differential equations of the first order and degree were solved by the Runge-Kutta-Gill method in a program written under Problem No. 1058. To continue analysis, changes have been made in the definition of the variables.

α_i, α_o, β, γ, Q and ρ may each be defined in any of three ways:

a. A constant
b. A function of standard time (in seconds)
c. A function of x (in degrees)

TITLE: Electron Density Function Tabulation
AUTHOR: Whelan, L.

INITIATOR: Tuan, T. (LKA)
PROJECT: 7661 PROBLEM NO. 1190

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 45_8k

An electron density function which arises in the theory of the ionospheric F layer is tabulated. The function is solved through use of an iterative procedure where a subroutine curve fits the coefficients in the first summation to experimental data for the function.

The program was designed as a main program and a collection of function subprograms in order to allow for modification flexibility.

TITLE: Ray Tracing
AUTHOR: Harris, S.

INITIATOR: Loewenstein, E. (OPI)
PROJECT: 7670 PROBLEM NO. 1191

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 66_8k

Optical ray paths are traced through (1) a toroidal-section central angle of 90°, (2) a right-angle bend with an elliptical mirror in the corner, and (3) a tapered cone.

For each case the ray enters and is traced through until exit from either end of the structure. The reflecting surfaces are all perfectly reflecting so that Snell's law for geometric optics is obeyed. Various histograms are computed, including density and cumulative. Provisions were also made for evaluation of an elliptical cylinder and elliptical cylinder wedge.

TITLE: Analysis of Solar Eclipse Data
AUTHOR: Armstrong, D.

INITIATOR: Straka, R. (LIR)
PROJECT: 5629 PROBLEM NO. 1192

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 12_8k

A statistical model is tested for brightness distribution of circular arcs across the disk of the sun against actual eclipse data at four different frequencies to determine which frequency most closely followed the theoretical curve. The output includes plots of actual eclipse data vs time and theoretical data vs the same period of time. This was done for all frequencies, and the slopes of each curve were also calculated and plotted in the same manner.

TITLE: Sunspot Coordinate Functions
AUTHOR: Hoffman, R.

INITIATOR: Kalaghan, P. (LZN)
PROJECT: 8682 PROBLEM NO. 1193

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 50_8k

This program is designed to compute and print tables of two special trigonometric functions to be used in sunspot coordinate transformations. The two functions to be computed are labeled B and X, and they are printed out in degree values. Formula calculations were as follows:

$$\text{Sin } B = \text{Sin } B_0 \times \text{Cos } P + \text{Cos } B_0 \times \text{Sin } P \times \text{Cos } X$$
$$\text{Cos } X = \text{Sin } P \times \text{Sin } Y \times \text{Sec } B$$

Appropriate calculations are made and tables are printed over the following variable ranges:

B from -7° to +7⁺ in 1° steps
P from 0. to 1. in .1 steps
Y from 0° to 360° in 10° steps

TITLE: Variability in Time of Height of Pressure Surface
AUTHOR: Kellaher, J.

INITIATOR: Sissenwine, N. (LKI)
PROJECT: 8624 PROBLEM NO. 1194

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 50_8k

The program effort accomplished involved the separation of work tasks as follows:

One set of programs was written to compute the root mean square change in height of various pressure levels for several time and space intervals. The computation obtains and tabulates the variation of a quantity previously computed from atmospheric sounding data, referred to collectively as the "Fort Sill" data. The heights of pressure surfaces are computed by linear interpolation on the natural logarithms of pressures. The distance components of the balloons are represented by the station-to-station distances, and are therefore the same at each pressure level. This is equivalent to pretending that the balloons all rise vertically from the launching stations. Actual time and space variability analysis is performed. (An improved version was developed under Problem No. 1212).

The other set of programs was developed to compute variability in time of height of pressure surface, for a set of data from Bedford soundings. The root mean square differences of two variables, height and temperature, are computed and tabulated at 30 specified standard pressure levels and for a specified set of class intervals of difference in time.

TITLE:	"Early Bird" Satellite Scintillation Data	
AUTHOR:	Hoffman, R.	
INITIATOR:	Allen, R. (LIR)	
PROJECT:	4643	PROBLEM NO. 1195
HARDWARE/SOFTWARE:	Not Applicable	
MINIMUM CORE SIZE:	Not Applicable	

A feasibility study on special scintillation data from the "Early Bird" satellite was preliminarily analyzed. The satellite was synchronous and thus appeared approximately stationary in the sky transmitting a steady plane-polarized signal. An antenna recorded the signal amplitude on a strip chart, which was digitized on a linear scale. Using these strip chart records, periods when sinusoidal modulation appeared smooth were selected as calibration data to construct references for comparison. Least-squares analysis would allow a scintillation index to be obtained. Included in this analysis is a flow chart, which was a first approximation to the required program. When the actual writing was undertaken, a number of difficulties were encountered, and they are explained in detail. The data was analyzed to the initiator's satisfaction, and then work ceased since the launching of the "Canary Bird" satellite would cause a redirection of the experiment.

TITLE:	Speech Analysis	
AUTHOR:	Navisky, D.	
INITIATOR:	Smith, C. (LRD)	
PROJECT:	4610	PROBLEM NO. 1198
HARDWARE/SOFTWARE:	IBM 7044/Fortran II, MAP	
MINIMUM CORE SIZE:	77_8k	

This program processed data which represented various speech characteristics, such as pitch and intensity. Mathematical results obtained from manipulating information contained on these tapes consisted of probability estimates, running sums of probability estimates, entropy values and other statistical functions relating specifically to the data being processed for each of the speech characteristics. Data could be handled in rank-ordered spectrum patterns.

Input tapes were constructed by collecting speech samples and analyzing them. The speech samples were recorded and then fed into a real-time analyzer that converted the spectrum, pitch and intensity levels of the voice signal into a digital representation. These tapes were then processed by the program. Program design permitted compilation of bi-variate distribution tables from the serial data tapes with flexibility to permit the selection of various options in processing–speech intensity vs spectrum level, speech intensity vs pitch, etc. The program also normalizes the distribution, compiles estimates of conditional probabilities and calculates estimates of the information in bits represented by the signal parameters.

TITLE: Magnetic Field Description and Analysis
AUTHOR: Coury, L.

INITIATOR: Sagalyn, R. (LIF)
PROJECT: 8617 PROBLEM NO. 1197

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 30_8k

Using a spherical harmonic analysis of the earth's magnetic field based on Cain-Hendrick's Coefficient, this program evaluates components of the earth's magnetic field and magnetic inclination and declination, all as a function of height. To analyze these components effectively, another coordinate system (B and L), also based on the Cain-Hendrick's Coefficient, is used to describe the earth's magnetic field. An additional stationary coordinate system is used as a frame of reference for the above obtained magnetic quantities. This is based on a first-degree harmonics analysis and is called the geomagnetic system (where the north and south geomagnetic poles are fixed). While the simple geomagnetic reference system is based on a simple dipole, the B and L system takes into account the non-dipole nature of the earth's field by organizing measurements along lines of force. The dipole distribution takes in effects of non-dipole characteristics (anomalies) by using the corrected coefficients for time changes.

TITLE: Markov Chain of Temperature Variate
AUTHOR: Dabcovich, M.

INITIATOR: Gringorten, J. (LKI)
PROJECT: 8624 PROBLEM NO. 1198

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 60_8k

This program is designed for the purpose of generating a Markov Chain of a temperature variate, given the initial value and the generating equation. The frequency distribution of the minima is found.

It is assumed that the variate, y, originally has a normal distribution with a mean of zero. In the Markov chain process this normal distribution gets modified by another normal distribution, and a relationship between these two is established.

TITLE: Power Spectral Da.a Correlation
AUTHOR: Dabcovich, M.

INITIATOR: Iliff, E. (LWW)
PROJECT: 7637 PROBLEM NO. 1199

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV,FAP
MINIMUM CORE SIZE: 77_8k

Programs were developed to perform cross-correlations of power spectral data as described below:

"BI50," a general-purpose Fourier Analysis program has the capabilities of dividing a given data set into overlapping windows, computing the Power Spectrum for each window at specified wavelengths, producing a sequential plot of spectra, and generating an input tape to be used with program "CBODO." Further capabilities of this program include smoothing and inverse Fourier Transforms.

"CBODO" reads the tape and generates annotated contour maps. These programs make it possible to compute and plot the time dependence and time variance of power distribution in a given sample.

Given a signal composed of message and noise, "FILTER" and "FILTER-3" compute an output signal. The purpose is to help the user pick a lag and a filter which will minimize the discrepancy between the output signal and the input signal with its noise removed. Also, the programs can find and plot the power spectrum of any signal given in tabular form and can find autocorrelation either from a given signal or from its power spectrum.

TITLE: Satellite Orbital Decay Projections
AUTHOR: Hoffman, R.

INITIATOR: Marcos, F. (LKB)
PROJECT: 6690 EM NO. 1200

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortr.. IV
MINIMUM CORE SIZE: 16_8k

Low-altitude satellite orbital decay parameters are computed for various upper-atmosphere models. The decrease in perigee altitude as a function of time is calculated, assuming a constantly varying scale height. The program, "LOWORB," uses two functions which interpolate for atmospheric density and density scale height for any altitude. Numerical analysis uses a fourth-order Newton's forward interpolation formula. The final results were used to help refine upper-atmosphere models.

TITLE: Gravity Harvest Data Reduction
AUTHOR: Fusco, J.

INITIATOR: Hicks, F. (LWL)
PROJECT: 7600 PROBLEM NO. 1201

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV, Map
MINIMUM CORE SIZE: 71_8k

The primary goal of this research effort was to predict average gravity values for one-degree sections over the surface of the earth. Gravity meter data recordings were acquired of the gravitational field at selected sites and at various altitudes. This data, recorded by three different meters aboard a specially-designed aircraft, was stored timewise on a digital data tape.

A main control program and a series of eleven subroutines were linked to form a chained operation for the purpose of reducing the data described above. These routines performed editing, plotting, listing, mathematical, logical and data-repair functions.

The output options included the following:

a. Printing of the contents of the internal data file for purposes of system error-checking and for obtaining intermediate results for the user.

b. Plots of the navigation parameters vs time for the purpose of studying the effects of smoothing, filtering and adjusting.

c. Plot to examine the effectiveness of the three gravimeters as compared with analytically-uplifted, true-anomaly values from Ohio State University.

d. Punched cards to provide Ohio State University with geocentric positions at which measured gravities are required.

TITLE:	Amplitude Data Analysis–Radio Propagation Study	
AUTHOR:	Kane, F.	
INITIATOR:	Rush, C. (LII)	
PROJECT:	5631	PROBLEM NO. 1202
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	24_8k	

A data conversion program was needed to analyze amplitude data that was generated during a radio propagation study. The data was initially collected via analog sensing equipment, digitized and presented as a Fortran-compatible tape.

The program operates within a time selection option, start, end and time interval. It converts the amplitude data and presents the results for any or all of the four recording channels.

Amplitude information will be used for the spectrum analysis. Modification may be required with respect to establishing a workable time interval. The results of the program are currently being used to evaluate existing radio propagation equipment.

Output consists of printed information made up of: time and converted amplitude data with flagged indicators signifying data which is out of range; plots representing trends over a time series; tape written in binary list format, containing total accumulated seconds and the data points of the channel or channels. This output is dependent upon the channel selection scheme.

The scope of this task was to establish the compatibility of the analog and digital data tapes. Establishing this compatibility allows the digital data to be subjected to power spectrum and cross-spectrum analysis.

TITLE:	OV3-1 Magnetic Field Computations	
AUTHOR:	Delaney, W.	
INITIATOR:	Smart, D. (PHE)	
PROJECT:	8600	PROBLEM NO. 1203
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	77_8k	

This program was written to calculate for the first 1000 orbits of the OV3-1 satellite the strength of the magnetic field, its direction and components. Calculations were performed at the satellite's position every 60 sec using ephemeris data.

The initial subprogram ASIGO calculates the suborbital points latitude, east longitude and altitude (KMS) of the satellite using SPADATS orbital elements.

The second subprogram WORKER then calculates the strength of the magnetic field at each point along with its direction and components. The program was designed to process all of the satellites data from the years 1960-1966.

TITLE: Infrared Lattice Vibration Reflectivity Spectra
AUTHOR: Noble, H.

INITIATOR: Kahan, A. (LQO)
PROJECT: 5631 PROBLEM NO. 1204

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 77_8k

The infrared lattice vibration reflectivity spectra of lithium fluoride and magnesium oxide were investigated. The dispersion parameters and associated optical constants were computed as a function of temperature. This was accomplished by approximating each of a number reflectivity curves, with curves generated from the theoretical equations. A permutation of oscillator parameter values was selected and a value for reflectivity was obtained for each of the experimental curve points. If the computed reflectivity value at every point was within a specified tolerance of the experimental curve value, then the permutation was said to be "successful," and these parameter values were used to compute reflectivity values for each input value of the independent argument. Those that were unsuccessful were output in a concise manner for that particular record. The program output both printer plots and Calcomp plots.

TITLE: Solution of Non-Linear Differential Equations
AUTHOR: Martine, J.

INITIATOR: Conley, T. (LIJ)
PROJECT: 5633 PROBLEM NO. 1205

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 17_8k

Two ordinary, non-linear differential equations of the form shown below were solved:

a. $$\frac{dNe}{dt} = q(N\,f(t) - Ne) - Ne\,f(t)$$

$$\text{VAR (1)} \Rightarrow Ne$$

b. $$\frac{dNe}{dt} = q(N\,f(t) - Ne) + \frac{Ne}{\dagger}$$

where $\dagger = (t - t_L)$

$$\text{VAR (2)} \Rightarrow Ne$$

A set of derivatives (N long) were calculated from the independent variable T according to the specifications of the equation being solved. Runga-Kutta-Gill method utilized.

TITLE: Telemetry Data Processing for OGO Satellites
AUTHOR: Coury, L.

INITIATOR: Bedo, D. (LKO)
PROJECT: 8688 PROBLEM NO. 1206

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV, MAP
MINIMUM CORE SIZE: 77_8k

Telemetry data from digital tapes was processed for experiment 20 of the OGO-C and OGO-D satellites. The experiment measured photons as a function of varying collimator scan positions for six detector states.

The data consisted of accumulated octal counts for each of the two photomultipliers; grey coded information that identified the collimator position for each count, and an identification code for the particular multiplexer and photocathode in use.

Solar radiation intensities in the 170° (absolute degrees) to 1700° (absolute degrees) region were measured with a scanning plane grating spectrometer.

For examining short-term intensity variations, the experiment could be commenced to execute short scans, which are uniformly distributed over the angular range of the full scan.

Printed output included scan position, associated photon count, peak value, and detector information. Plots of collimator scan position vs photon counts were generated.

TITLE: OV3-2 Plasma Probe Merge
AUTHOR: Chin, J.

INITIATOR: Sagalyn, R. (LIF)
PROJECT: 8617 PROBLEM NO. 1207

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 77_8k

A play-back (tape recorder) of real-time 30-segment commutator data tape was processed. The data tape contained information collected by instruments attached to the OV3-2 Spacecraft for the Plasma Probe (PAP) experiment. The information on the tape was unpacked and the segments were converted to values in terms of volts. The processed data was then merged with information from an ephemeris tape to produce a merged binary tape.

Each ephemeris record contained 60 sec of information and produced 60 sets of output data. The program was capable of reading specific clocksums with associated correction factors to adjust the GMT accurately if normal checking procedures in the program failed to correct unusual time gaps.

TITLE:	Average Fourier Power	
AUTHOR:	Grossbard, N.	
INITIATOR:	Conley, T. (LLJ)	
PROJECT:	7663	PROBLEM NO. 1208
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV, MAP	
MINIMUM CORE SIZE:	54_8k	

A frequency spectrum whose frequency varies with time was analyzed.

The data was divided into consecutive groups of 4096 points each, and each set of 4096 values was analyzed by using the Fast Fourier Transform (F.F.T.) method. The final result consisted of the average of the power spectral results for each of these groups.

Linear interpolation was used to determine the approximate skin frequency at the average time of the data. The skin frequency was then set as the frequency within 100 cycles of this approximation at which the maximum power occurred. The program also used a numerical filtering method to smooth the data.

Pen-and-ink plots of power vs frequency - S(t) (where S(t) is the skin frequency, which is a function of time) were produced.

TITLE: Temperature Distribution on a Cylindrical Sapphire Rod
AUTHOR: Spuria, A.

INITIATOR: Sampson, J. (LQP)
PROJECT: 5620 PROBLEM NO. 1209

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 54_8k

The problem concerned the growth of single crystals of refractory materials by the focusing of light or infrared radiation from lamps or lasers upon the material to be melted or recrystallized. Energy can be focused on a long, thin rod of material until a portion of the rod melts. With the solid material above and below this molten zone held in place, the surface tension acts to keep the molten zone steady between the portions. If the whole assembly is moved slowly downward through the beam of input energy, material from the molten zone freezes at the bottom and is replaced by molten material from above. Under the proper conditions, large single crystals result.

In the course of investigation it became necessary to learn the theoretical temperature and temperature gradient along the rod between the molten zone and the mounting chunks. This information gives the power input required, and from this the requirements for CO_2 lasers as power sources can be determined.

The purpose of the program is to solve the second-order ordinary differential equation

$$YDP = Y^{11} = \frac{d^2t}{dt^2}\left(\frac{2\cdot E\cdot S}{F\cdot TK}\right)(Y^4 - TAU^4)$$

for various initial conditions and rod length intervals. This equation determines the temperature distribution along a cylindrical sapphire rod heated at one point until a zone melts, and calculates the amount of power needed to maintain the melt. The results hopefully will aid in the experimental setup for perfecting artificial gems through the use of laser power.

TITLE: OV3-2 Data Merge
AUTHOR: Jacobs, L.

INITIATOR: Cohen, H. (LKB)
PROJECT: 6687 PROBLEM NO. 1210

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV, MAP
MINIMUM CORE SIZE: 22_8k

The OV3-2 120 Pin Merge Program was written to merge the telemetry data of the 120 segment commutator of the OV3-2 vehicle with corresponding ephemeris data.

The commutator data was converted from counts to volts and merged with interpolated ephemeris data. A maximum of two playback orbits may be processed in one computer run. Real-time orbits can also be processsed by this program.

An output tape, consisting of a 15-word header record, 450-word data records, and an end-of-orbit record was generated.

TITLE: Solution of an Integral Equation
AUTHOR: Russell, J.

INITIATOR: Tsipouras, P. (SUYA)
PROJECT: 0001 PROBLEM NO. 1211

HARDWARE/SOFTWARE: N/A
MINIMUM CORE SIZE: N/A

Mathematical analysis was performed in order to find the solution of an integral equation of the convolution type. Investigation involved solving the integral equation:

$$N(t) = \int_{-\infty}^{\infty} I(t-\tau)\, S(\tau) d\tau$$

where the functions N(t) and $S(\tau)$ are to be considered Gaussian functions. The equation was transformed by use of the Operational Transform defined by:

$$L\left\{F(t)\right\} = \int_{-\infty}^{\infty} e^{-st^2}\, F(t) dt$$

and solved for S(t).

TITLE:	Atmospheric Variability Analysis	
AUTHOR:	Kellaher, J.	
INITIATOR:	Lenhard, R. (LKI)	
PROJECT:	8624	PROBLEM NO. 1212
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	31_8k	

Several programs were written to analyze wind speed components from soundings made at Fort Sill, Oklahoma, at 1000-ft intervals up to 50,000 ft.

Soundings were paired in time, and the root-mean square differences in component wind speeds for appropriate class intervals of distance were obtained. The basic class interval sizes were 15 minutes and 5 nautical miles.

The program was designed to accept mandatory pressure level data or run for all 1000-ft levels. The printed listing considered eight days of soundings computed at 50 levels and various class intervals. Distance components in feet and nautical miles between release point for East and North components were also printed.

TITLE:	Solution of OV3-2 Aspect Data	
AUTHOR:	Pruneau, P.	
INITIATOR:	Cohen, H. (LKB)	
PROJECT:	6687	PROBLEM NO. 1213
HARDWARE/SOFTWARE:	IBM 7094 II - 7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	71_8k	

Meaningful aspect parameters for the OV3-2 satellite were derived by aspect analysis.

The program utilized merged data tapes (tapes provided by AFCRL and containing ephemeris and the corresponding experiment data for assigned orbits) to compute aspect parameters. These aspect parameters included the aspect (with respect to a fixed coordinate system in space) of the axis of the OV3-2 spacecraft and of several probe vectors perpendicular to this axis. The aspect parameters also included the angles of attack of each of the above vectors with respect to the vehicle velocity vector and other given vectors (that is, the earth's magnetic field vector, the sunline vector, etc.).

The program generated a listing of these aspect parameters and a binary tape for use by interested experimentors. Also, Calcomp plots of the parameters vs Greenwich Meridian Time (in seconds) were produced to display a representative amount of the aspect parameters.

TITLE:	Relationship of Rainfall to Atmospheric Circulation
AUTHOR:	Armstrong, D.
INITIATOR:	Lund, I. (LKI)
PROJECT:	8624 PROBLEM NO. 1214
HARDWARE/SOFTWARE:	IBM 7044; IBM 7094 II-7044 DCS/Fortran IV, MAP
MINIMUM CORE SIZE:	60_8k

In recent years a sufficient number of observations from upper levels of the atmosphere have become available and are useful in determining if changes in the general circulation aloft are related to subsequent cloud and rainfall activity.

This particular study aimed at predicting the rainy season in South Vietnam. Several programs were written to process pressure height data and rainfall amounts recorded twice daily at 1977 different stations in the Northern Hemisphere covering the period 1 January 1962 to 9 October 1966.

The statistical approach to this problem involved categorizing several weather types and then correlating this data with pressure height data for the corresponding days, stations and millibar levels.

This effort produced results which were useful, but in general insufficient for warranting continuation in this direction. Work performed under Problem No. 1446 was more successful from an operational standpoint.

TITLE:	Verification of Weight Distribution
AUTHOR:	Grossbard, N.
INITIATOR:	Pierce, J. (LRA)
PROJECT:	5628 PROBLEM NO. 1215
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	25_8k

Two programs calculate and print out two equations without round-off for the purpose of verification of weight distribution. Multi-precision, fixed-point arithmetic subroutines are used for addition and multiplication.

"PIERCE 1" finds B(R), where

$$B(R) = \sum_{J=6}^{20} J^R \; A(J).$$

"PIERCE 2" calculates C(R) for

R = 1, 2, ...14, where

$$C(R) = 3^{(30-2R)} \sum_{K=1}^{R} 2^K \, 2^{(R-K)} \, S(R,K) \prod_{M=(16-K)}^{60} M$$

"PIERCE 1" was originally written under Problem No. 1619.

TITLE:	Computation of Representation Errors
AUTHOR:	Navisky, D.
INITIATOR:	Anthony, D. (LWH)
PROJECT:	7600 PROBLEM NO. 1216
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	77_8k

The most economical flight patterns (consisting of east-west and north-south flights) for gravity-detecting aircraft to fly over certain areas of the earth's surface were found by computing the error caused by obtaining the gravity value from a finite number of profiles (paths), which represented the main gravity value of an area. The resulting error was called the "representation error."

By computing the representation errors for various flight profile combinations and considering these errors in the total error budget, which includes gravity sensors, navigation, etc., it was possible to plan the most economical flight patterns suitable for harvesting gravity data.

The number, position and direction of the profile were input, and the representation error, along with its intermediate results, was output.

TITLE:	Investigation of Radiation Patterns
AUTHOR:	Grossbard, N.
INITIATOR:	Thomson, K. (LWW)
PROJECT:	7639 PROBLEM NO. 1217
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	13_8k

Program "TABLES" makes a parameter study of two equations:

a. $$U_p(\theta) = \frac{1-2/A^2 \cos^2\theta}{A/C - \cos\theta}$$

and

b. $$U_s(\theta) = \frac{\sin 2\theta}{1/C - \cos\theta}$$

where A, C and θ are input parameters. The extrema U_p and U_s are found, the equation for U_s being derived from Newton's Method. Maximum values are also determined. The equations are a model for a study of two-dimensional seismic radiation patterns from propagating cracks.

TITLE: Diurnal Variation Effects on M-Hour Minimum Temperatures
AUTHOR: Harris, S., and Hornik, G.

INITIATOR: Gringorten, I. (LKI)
PROJECT: 8624 PROBLEM NO. 1218

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 34_8k

Several programs were written to study the effects of the diurnal variation on the M-hour minimum temperatures. The objective was to find, in a Markov Chain, the effect of the M-hour minimum of variable Y that had a normal distribution on any single hour of the day. A chain of minimum temperatures was generated on a continuous basis. The probability distribution of a continuous variable (N(Y/O,1)) was generated over an interval of M hours when there was an hour-to-hour correlation "P" in a Markov chain. The process was repeated for 100, 250, 500 and 1000 months with the histogram and cumulative distributions computed and printed.

TITLE: Estimation of Total Radiance
AUTHOR: Wright, B.

INITIATOR: Lund, I. (LKI)
PROJECT: 8624 PROBLEM NO. 1219

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 77_8k

A series of programs were written to analyze surface weather observations for the purpose of estimating total radiation, using several parameters as predictors.

The weather observational data consisted of date; maximum, minimum and average temperatures; positive and negative temperature departures from normal; snowfall; snow on ground; wind direction (degrees); wind speed; fastest speed; total hours of sunshine; percent of possible sunshine; sky cover sunshine to sunset; total radiation; station pressure; vapor pressure; and hours of precipitation. The data was arranged chronologically from 1 May 1950 through 30 April 1959.

The variables for total hours of sunshine, percent of possible sunshine, sky cover sunrise to sunset, total radiation and hours of precipitation were curve-fitted.

Several combinations of variables were used as predictors in a screening regression technique to predict the total radiation.

TITLE:	Complex Refractive Index in an Ionized Medium
AUTHOR:	Kellaher, J.
INITIATOR:	Sales, G. (LII)
PROJECT:	5631 PROBLEM NO. 1220
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS; CDC 6600/Fortran IV
MINIMUM CORE SIZE:	42_8k

Program "M69310" evaluates a set of equations known as the Appleton-Hartree formula to obtain the complex refractive index and polarization of the characteristic modes in an ionized medium.

The values of the altitude at which the Appleton-Hartree formula is to be evaluated and the density and collision frequency at each of these altitudes are computed. Printout consists of the input data, consisting of propagation frequency, gyrofrequency, angle between wave normal and magnetic field, etc.; the input electron density profile or the input collision frequency profile with the corresponding heights; tables of the computed values; tables of the interpolated values; and intermediate output. Plots are also output.

TITLE: Southeast Asia Meteorological Forecasting Study
AUTHOR: Armstrong, D.

INITIATOR: Conover, J. (LYS)
PROJECT: 6698 PROBLEM NO. 1221

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 70_8k

The air of these studies was to improve the forecasting of weather occurrences over Southeast Asia (SEA). Studies range from the development of simple empirical relationships and models which can be applied in the preparation of forecasts to more basic studies which are required for understanding the weather of the area.

For wind analysis one group of programs collected data from ETAC tapes, which included wind velocity and direction and gradient wind direction at various levels. A second group of programs edits and sorts wind data from cards. Both series produce tapes containing chronological records and used as input to a wind analysis program. The analysis program interpolates the data through the use of a mathematical routine developed by S.L. Barnes. The vorticity and divergence of the winds are also calculated, and charts of input direction and speed, orthogonal components of speed, interpolated wind direction and speed, vorticity, and divergence are output. The results are used to calculate cloud cover.

Statistical pressure-height analysis included calculations of averages, deviations, differences and correlations. Lags are included and various weather types analyzed. Weather maps were output to enable isoplates to be drawn and patterns to be identified in weather activity. An example is correlation with precipitation patterns to understand variations in monsoon activity.

Also the investigation of the relationship between cloudiness and precipitation activity is analyzed to contribute to the determination of regression equations to yield a forecast of activity and enable weather predictions over SEA.

TITLE: Prediction of Speech Intelligibility Variable
AUTHOR: Conway, E.

INITIATOR: Smith, C. (LRD)
PROJECT: 4610 PROBLEM NO. 1222

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 15_8k

The program was written for the analysis of multivariate data in order to construct models to predict the expected value of a variable as a function of two other variables. The dependent variable is speech intelligibility and the independent variables may be any one of the following three combinations:

a. mean spectrum error (voiced)
   mean spectrum error (unvoiced)

b. spectrum information (voiced)
   spectrum information (unvoiced)

c. total voiced patterns
   total unvoiced patterns

The program computes a multiple linear regression model and a quadratic regression response surface. For each model, it computes the predicted values and deviations, testing the fit at the 5 percent significance level using an F-test.

TITLE: Quality Control and Reformatting of A-to-D Tapes
AUTHOR: Atkinson, J.

INITIATOR: Penney, R. (SUYR)
PROJECT: 5173 PROBLEM NO. 1223

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 26_8k

A method for maintaining quality control and reformatting of the Decommutation Branch analog-to-digital output data tapes is devised to give the user an unpacked tape that can be processed directly on a major computer system.

The program accepts a packed digital binary tape containing data in counts and time words in packed BCD in binary format. The time words are reformatted, the data words are unpacked and converted, and a reformatted binary tape is generated for further processing.

TITLE: Analysis of Radar Doppler Data
AUTHOR: Grossbard, N.

INITIATOR: Dyer, R. (LYW)
PROJECT: 6672 PROBLEM NO. 1224

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 64_8k

Radar doppler data was reduced from a provided data tape into logical records of 8192 values on which is performed a Fourier analysis. The Fourier series associated with the data groups are determined and placed on an output. Also the mean, variance and an estimate of power over a restricted portion of the transformed data are computed. The variance is rescaled and times reset for drum plot output.

The CDC version of these programs may be found under Problem No. 1565.

TITLE: Multiple Regression Analysis of Rainfall Intensity
AUTHOR: Whelan, L.

INITIATOR: Lenhard, R. (LKI)
PROJECT: 8624 PROBLEM NO. 1225

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 55_8k

Individual and multiple regressions are desired of the forms

$$X_1 = a_{1i} + b_{1i}X_i \qquad i = 2, 3$$

$$X_1 = a_{1.23} + b_{12.3}X_2 + b_{13.2}X_3$$

where X_1 = rainfall intensity
X_2 = total precipitation/days with rain
X_3 = temperature warmest month - temperature coldest month.

Data is given for 203 stations over which summations are to be made and regression statistics calculated for each combination of the eight duration times and four return periods. Thirty-two sets of regression equations result. Standard errors of estimate and F ratios for the analysis of variance are also computed.

TITLE:	Atmospheric Corrections for Sun Meridian Crossings	
AUTHOR:	Delaney, W.	
INITIATOR:	Smart, D. (PHE)	
PROJECT:	8666	PROBLEM NO. 1226
HARDWARE/SOFTWARE:	IBM 7044/Fortran IV	
MINIMUM CORE SIZE:	15_8k	

A table of atmospheric corrections for meridian crossings of the sun at a given latitude was computed. In this case, the latitude was 42.4°, the latitude of Hanscom Field, Bedford, Massachusetts.

Given the local hour angle (XLHA), the declination (DEC), station latitude (XLAT), and ending declination angle (ENDEC), the program computed the elevation angle. The zenith angle was also calculated. A table of values was printed for each declination from start to end in one-degree intervals.

TITLE:	OV1-15 Ion Gauge Pressure Plot	
AUTHOR:	Fioretti, R.	
INITIATOR:	McIssac, J. (LKB)	
PROJECT:	6690	PROBLEM NO. 1227
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	14_8k	

The OV-15 Ion Gauge pressure plot program, "PGPLOT," using pre-processed tapes containing OV1-15 satellite data, displays ion pressure from a particular ion gauge as a function of GMT and satellite altitude. Gauge pressure is displayed in a CRT plot, which will show satellite spin and precision effects on the ion gauge outputs. Included on this plot are ion gauge ID, satellite rev number and date.

The program has the following options and capabilities:

a. Processing either gauge #1 or gauge #2 data.

b. Variable-length axes—the x-axis is dependent upon the satellite spin period.

c. Processing data below a chosen altitude.

d. Skipping orbits/files which are not to be plotted.

These features are under input card control and are easily changeable.

TITLE: Measurement of Time Delay of Satellite Signals
AUTHOR: Grossbard, N.

INITIATOR: Kidd, W. (LIR)
PROJECT: 4643 PROBLEM NO. 1228

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 62_8k

Two programs were written in order to measure time delay of signals from a satellite to a ground station and to subsequent stations. All pertinent data from input cards and input tape was listed, and a printed graph of the data was produced. Also, the power spectrum was found, and an autocorrelation was performed for each channel of data. A cross-correlation of both channels was made as well. The results were plotted.

TITLE: Electron Density Data Plots
AUTHOR: Fioretti, R.

INITIATOR: Marcos, F. (LKB)
PROJECT: 6690 PROBLEM NO. 1229

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 23_8k

The OV1-15 Triaxial Accelerometer density plot program was written to display the final output densities from the Y-axis accelerometer as a function of satellite altitude, and then to plot this same data along with a least-square polynomial fit of the density data. Preprocessed tapes produced in Problem No. 1526 are used as input to this program.

The purpose is to choose only densities where the measured satellite drag (averaged over one second) is at a maximum and a minimum.

TITLE: Evaluation of Suns--Inversion of 16-by-16 Matrix
AUTHOR: Pustaver, J.

INITIATOR: Thomas, K. (LWW)
PROJECT: 7639 PROBLEM NO. 1230

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 16_8k

A system of linear equations (described below) was solved.

$$E_i(W) = \sum_{R=1}^{16} \frac{E_R W_R^2}{t_R^{-2} + W_R^2}; \quad i = 1,\ldots,16$$

where $E_i(W)$, W_R and t_R are specified and E_R are to be determined.

The method of conjugate gradients was chosen for the solution because of the ill-conditioning in the matrix of coefficients. Since the method of conjugate gradients is only useful for symmetric matrices, and since the matrix of coefficients in this problem is non-symmetric, the problem had to be modified to solve

$$A^T AX = A^T b$$

where A is the matrix of coefficients
b is the $E_i(W)$ vector
X is the E_R vector to be found.

TITLE:	OV3-6 Smoothing and Current Conversion	
AUTHOR:	Desrochers, R.	
INITIATOR:	Philbrick, C. (LKD)	
PROJECT:	6687	PROBLEM NO. 1231
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	76_8k	

The OV3-6 satellite, launched in December, 1967, was designed to measure the composition of the earth's atmosphere at 435 km.

This program serves three functions in the OV3-6 IMS processing cycle as follows:

a. To smooth the mass peaks.

b. To convert volts to amps and write new output tape.

c. To plot current vs time for each mass.

The data is averaged over an interval of 17 values by using a non-weighted running mean. Values which deviate from the mean by more than 0.5 volts are eliminated.

The data is then converted to amps and each mass is plotted against time.

The smoothing intervals and values and the conversion table are all input to the program and can be changed to accommodate a different data set.

TITLE:	Satellite Position Calculation	
AUTHOR:	Almon, A.	
INITIATOR:	Hussey, I. (SUYA)	
PROJECT:	0001	PROBLEM NO. 1232
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV	
MINIMUM CORE SIZE:	41_8k	

The radius in feet, the velocity in ft/sec, and the azimuth in all four quadrants were computed for a satellite at injection, given the apogee and perigee (in km or nautical miles), latitude, and inclination of the satellite.

Output consists of a listing of each vehicle's apogee and perigee, its radius in feet, and its velocity in ft/sec.

TITLE: Paper Tape to Punched Cards
AUTHOR: Powell, P.

INITIATOR: Cormier, R. (LII)
PROJECT: 5631 PROBLEM NO. 1233

HARDWARE/SOFTWARE: CDC 6600; CDC 3694/Fortran IV
MINIMUM CORE SIZE: 45_8k

Data from eight-track paper tape from AFCRL special laboratory equipment was transferred to punched cards. "Frames" of information from a paper tape were placed in an array in central memory, five frames per core memory word. A "frame" is defined as a column of bits which makes up a single character.

All alphanumeric characters as developed by the American Standards Code for Information Interchange (ASCII) can be converted. The ASCII code uses seven bits plus a parity bit.

The program can be expanded to convert special characters.

TITLE: Variability of Ionospheric Refractive Index
AUTHOR: Grossbard, N.

INITIATOR: Elkins, T. (LIR)
PROJECT: 4643 PROBLEM NO. 1234

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 70_8k

A Fourier analysis was made of the high (compared to one cycle per day) frequencies found on a special input data tape containing satellite interferometer readings.

The power spectrum for each 24-hour data sample was computed and printed.

Filtered data in a simulated-frequency response curve and the power spectrum were plotted.

The computed results provided information on the variability of ionospheric refractive index and on traveling waves in the ionosphere.

TITLE: Electrical Circuit Analysis
AUTHOR: Dieter, K.

INITIATOR: Mallumian, L. (LRL)
PROJECT: 4641 PROBLEM NO. 1235

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 77_8k

In order to check out electrical circuits, it is desirable to have a convenient means of locating the connections within a circuit which result in electrical flow. The proper connection within a given circuit is determined analytically.

"CYCLES" first generated all cycles, or circuits, within a polygon with a specified number of vertices. However, in so doing, it avoided those cycles which had any "forbidden edges." These edges (sides and diagonals) were specified in advance by the user, and were designated by a serial number which, for a 9-gon, ran from 1 through 36. The complete list of all edges with their corresponding vertices was given at the beginning of the output. The user must refer to this list in order to indicate properly those edges he wishes to omit.

After generating all 1553 cycles (for a 9-gon), the program sorted out these cycles into "cycle sets," each set containing all of the edges of the 9-gon (except the omitted edges), each edge appearing just once in a given cycle set. Thus, each cycle set was a union of 3 disjoint cycles.

TITLE: Trajectory Program Development
AUTHOR: Hicks, L.

INITIATOR: Cronin, E. (SUYA)
PROJECT: 0001 PROBLEM NO. 1236

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 31_8k

The rectangular (X,Y,Z) components and their derivatives of a missile relative to its launch site were evaluated with regard to refraction effects. The components, their derivatives and the altitude values were curve-fitted, and the geodetic latitude and longitude of each point generated were determined.

In order to obtain the X-Y-Z launch, all radar positions evaluated from azimuth, elevation and slant range were rotated from the radar's reference frame to the launch site. Corrections were applied to elevation and range by using a five-layer analysis for refraction effects with an exponential fit to each layer, summing the contributions from each layer.

In addition, data from multiple radar sites was evaluated. A curve combining time and X-Y-Z launch values was generated and used to obtain a 6th-order polynomial fit over the upper part of the trajectory. This polynomial was used to solve for three points needed to evaluate the orbital elements of a Keplerian ellipse.

TITLE:	Satellite Scintillation Index Program
AUTHOR:	Delaney, W.
INITIATOR:	Aarons, J. (LIR)
PROJECT:	4643 PROBLEM NO. 1237
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	28_8k

Satellite data was extracted from input cards and plotted according to a specified format.

One plot gave the scintillation index vs the subion latitude and the latitude of the recording station, whereas the second plot showed the subion latitude vs subion longitude with the latitude and longitude of the recording station.

TITLE:	Proton Energy Data Reduction
AUTHOR:	Fusco, R.
INITIATOR:	Kuck, G. (PHE)
PROJECT:	8600 PROBLEM NO. 1238
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	12_8k

This program was written to extract selected parameters from data tapes containing rocket (CRL-35) range data for the purpose of analyzing proton energy data. The proton energy spectra from L = 2 to L = 3 were measured by a two-detector solid-state telescope carried by a rocket launched 30 March 1965. Input to the program consisted of the starting time of data to be extracted and the time duration.

TITLE:	Reflection of Quasimonochromatic Radiation
AUTHOR:	Delaney, W.
INITIATOR:	Poirier, J. (LZP)
PROJECT:	4642 PROBLEM NO. 1239
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	77_8k

The reflection of quasimonochromatic radiation from random discontinuities in a long transmission line was investigated with the use of the theory of partial coherence.

The program computed probability density functions for the power reflection coefficient at the input to the line as a function of the special characteristics of the illuminating signal, the properties of the propagation medium, and the distribution of the scatterers.

TITLE: Fort Sill Sounding Measurements
AUTHOR: Birtwell, R.

INITIATOR: Lenhard, R. (LKI)
PROJECT: 8624 PROBLEM NO. 1240

HARDWARE/SOFTWARE: IBM 7044/Fortran IV
MINIMUM CORE SIZE: 77_8k

The purpose of the program "Azelde" was to examine the Fort Sill sounding measurement data and determine if any bad data existed. The evaluation of the data was left to the discretion of the researcher.

The Azelde Program read each tape record and found the first differences of the azimuth and elevation angles which appeared in that record. The program printed the angles, their differences, the time the data was recorded and the pertinent data applying to that record (day, month, station number, time, and release time) for the entire tape.

TITLE: OV3-6 Mass Spectrometer Plot Data
AUTHOR: Desrochers, R.

INITIATOR: Philbrick, R. (LKD)
PROJECT: 6687 PROBLEM NO. 1241

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 75_8k

This program is used primarily to produce an output plot of Greenwich Mean Time (GMT) in total seconds vs Mass Spectrometer II (MS II) ion mass data in a current form. The angle of attack is also plotted. A latitude scale is provided on the plot at every inch of plotting surface. The program is used to process OV3-6 Ion Mass Spectrometer (IMS) experimental data.

TITLE: OV3-6 MS II Neutral Pressure Conversion and Plot
AUTHOR: Desrochers, R.

INITIATOR: Philbrick, C. (LKD)
PROJECT: 6687 PROBLEM NO. 1242

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 77_8k

The purpose of this program is to convert OV3-6 MS II Neutral Mode Mass Data in current form to pressure and provide an output plot of pressure for various gases vs Greenwich Meridian Time (GMT). A subroutine written under Problem No. 1245 is used to calculate the ambient neutral gas temperature.

The input to this program consists of the following:

a. Control cards specifying masses of interest, variables for the temperaature subroutine and conversion factors for each mass.

b. A tape file containing mass data in current form, ephemeris data and aspect data.

The output is a listing of mass peaks in pressure form and a plot of designated masses.

TITLE: Radiative Transfer Solution Program
AUTHOR: Armstrong, D.

INITIATOR: Falcone, V. (LZN)
PROJECT: 8682 PROBLEM NO. 1243

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 17_8k

The radiative transfer equation, established by the researcher, was solved, given the frequency and number of data sets related to that frequency. Each data set contains a measurement of height, temperature, pressure, relative humidity and saturation vapor pressure.

The purpose was to solve numerically the radiative transfer equation for any number of sets of measurements. Each measurement set was related to the frequency parameter, which was also an input to the program.

The researcher's description of the radiative transfer equation was as follows:

$$T_r = T_s (e - \tau_o \sec \theta) + \int_o^\infty T(X)\, a(X) \sec \theta \left(e - \int_o^s a(X) \sec \theta\, dX\right) dX$$

where $\tau = \int a(X)\, dX$

$a(X) = a_w(X) + a(X)$; in reality $a = a(T,P,RH,v)$.

TITLE: OV3-6 MS I Neutral Pressure Conversion and Plot
AUTHOR: Desrochers, R.

INITIATOR: Philbrick, C. (LKD)
PROJECT: 6687 PROBLEM NO. 1244

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 51_8k

The purpose of this program is to convert OV3-6 MS I mass peak data in current form to pressure and provide a plot of each mass vs time. A subroutine written under Problem No. 1245 is used to calculate the ambient neutral gas temperature.

The input to this program consists of (1) a data file containing IMS, ephemeris and aspect data, and (2) control cards designating masses of interest, variables for the temperature subroutines, amps/mm conversion table and coefficients for computing the internal temperature.

The output of this program is a listing of mass peaks in pressure form and a plot of each mass (pressure vs GMT).

TITLE: Ambient Neutral Gas Temperature Subroutine
AUTHOR: Desrochers, R.

INITIATOR: Philbrick, C. (LKD)
PROJECT: 6687 PROBLEM NO. 1245

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 1_8k

The OV3-6 satellite, launched in December, 1967, was designed to measure the composition of the earth's atmosphere at 435 km. The OV3-6 data processing system is part of the Satellite Data Reduction Processor System (SADAR), which provides a general system for retrieval of experimental measurements.

A subroutine was written to perform the specific task of calculating the ambient neutral gas temperature of the atmosphere. This subroutine is used by a variety of programs (for example, programs written under Problem Nos. 1242 and 1244).

TITLE:	OV3-6 Mass Spectrometer	
AUTHOR:	Williams, D.	
INITIATOR:	Philbrick, C. (LKD)	
PROJECT:	6687	PROBLEM NO. 1246
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	11_8k	

The purpose of the OV3-6 Ion Mass Spectrometer (IMS) Merge Program is to provide a composite tape of ephemeris, aspect and 60-segment commutator data. This tape will be used to analyze the experimental data in other programs.

"IMS MERGE" merges OV3-6 Ion Mass Spectrometer data with the aspect tape containing 60-segment commutator data, ephemeris, and aspect data. A binary tape is written and certain portions of the merged record are listed. The commutator data, ephemeris, and aspect data are all referred to as aspect data.

TITLE:	Solar Antenna Study	
AUTHOR:	Grossbard, N.	
INITIATOR:	Burak, M. (LZN)	
PROJECT:	8682	PROBLEM NO. 1247
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE.	30_8k	

This effort was directed toward providing a benchmark program to simulate tracking of astronomical bodies with a radio telescope. The benchmark program was written to aid in the selection of a suitable control processor needed for a command generating unit which would provide digital directional commands in azimuth and elevation to an antenna pedestal and servo system. The commands were to be employed principally to direct the antenna in tracking astronomical bodies in the solar system or on the celestial sphere.

TITLE:	Conversion of Count Values to Gamma Values	
AUTHOR:	Armstrong, D.	
INITIATOR:	Chernosky, E. (LKA)	
PROJECT:	8601	PROBLEM NO. 1248
HARDWARE/SOFTWARE:	IBM 7094 II - 7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	1_8k	

Five-minute count values on a magnetic tape were converted from relative scanner units to absolute gamma units. The program provided basically a smoothing technique of the data and removed noise.

The handling of data was facilitated when being compared to a base line.

The converted sums and differences, together with their associated times, were listed in a printout and on magnetic tape.

TITLE:	Determination of Radio Temperature of the Atmosphere
AUTHOR:	Delaney, W.
INITIATOR:	Falcone, V. (LZN)
PROJECT:	8682 PROBLEM NO. 1249
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	17_8k

The radio temperature of the atmosphere was determined by means of the radiative transfer equation.

Sets of cards containing five basic parameters—height, temperature, pressure, relative humidity, and saturation vapor pressure—were input. Secondary statistical and mathematical values were calculated, and integration was performed by means of Simpson's Rule and the Trapezoidal Rule.

Results of the estimated temperatures were presented as output on the on-line printer.

TITLE:	OV1-9 Data Merge
AUTHOR:	Hackett, J.
INITIATOR:	Smart, D. (PHE)
PROJECT:	8600 PROBLEM NO. 1250
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	23_8k

Satellite data recorded on the OV1-9 vehicle was processed. The input data tape and ephemeris tape were searched for corresponding voltage readings and time, and then the two sources of information were merged onto an output tape. The time, volts, longitude, latitude and altitude of the satellite were extracted from the two tapes, also.

TITLE:	OV1-10 Data Merge
AUTHOR:	Hackett, J.
INITIATOR:	Hutchinson, R. (PHG)
PROJECT:	7601 PROBLEM NO. 1251
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	77_8k

Magnetic field data on digital tapes prepared from OV1-10 satellite raw telemetry tapes was reduced in order to provide (1) a listing of the raw voltages converted to counts for pins 25, 26, 27, 28 and 29 of channel 16, and (2) a listing of voltages vs range time for all information on pin 1, channel 16.

TITLE:	Fourier Analysis of Rocket Exhaust	
AUTHOR:	Grossbard, N.	
INITIATOR:	Conley, T. (LIJ)	
PROJECT:	7603	PROBLEM NO. 1252
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV, MAP	
MINIMUM CORE SIZE:	52_8k	

Several programs were written to aid in the analysis of scattering from ionized trails in the upper atmosphere. Investigation included the ionized wakes of re-entry vehicles and rocket exhaust trails.

In particular, the program found the Fourier power at a particular frequency after attempting to remove a linear variation in the data.

Graphs of Fourier power vs frequency from many sets of data were plotted.

TITLE:	Electron Density	
AUTHOR:	Crowley, P.	
INITIATOR:	Sagalyn, R. (LIF)	
PROJECT:	8617	PROBLEM NO. 1253
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	35_8k	

Experiment 12 aboard the OGO-A satellite was designed to measure flux, temperature and energy distribution of electrons and positive ions.

Two programs process electron and ion flux data in two energy ranges. Low energy particles from 0 to 25 electron volts and high energy particles from 25 to 1000 electron volts were measured.

Output consists of at least one plot (Calcomp, off-line CRT, or CRT batch) of particle vs universal time. Digital output of universal time, event monitor level, sensor current and computed flux may also be provided.

TITLE:	Partial Pressure From Ion Intensities	
AUTHOR:	Kellaher, J.	
INITIATOR:	Murad, E. (LKB)	
PROJECT:	8605	PROBLEM NO. 1254
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	12_8k	

In connection with a study for the determination of partial pressures from ion densities, a non-linear system of 13 equations with 13 unknowns was formulated.

Since there existed a functional dependence in the system, several methods of analysis were investigated in the elimination of variables.

TITLE: Analysis of Solar Eclipse Data
AUTHOR: Armstrong, D.

INITIATOR: Aarons, J. (LIR)
PROJECT: 5629 PROBLEM NO. 1255

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 25_8k

A statistical model was tested for brightness distribution of circular arcs across the disk of the sun against actual eclipse data at four different frequencies to determine which frequency most closely followed the theoretical curve.

The output included plots of actual eclipse data vs time and theoretical data vs the same period of time.

TITLE: Analysis of Roots of Cubic Equations
AUTHOR: Kellaher, J.

INITIATOR: Kriger, L. (LRS)
PROJECT: 4610 PROBLEM NO. 1256

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 17_8k

The roots of cubic equations of a certain type were computed and tabulated to aid in the design of audio phase interference filters.

A cubic equation of the form $Z^3 + A_1 Z^2 + Z + A_3 = 0$, with real coefficients A_1 and A_3, may have one real root and two conjugate complex roots, or it may have three real roots. The nature of the roots is indicated by the sign of a real number D_1, called the discriminant, which is computed from the coefficients A_1 and A_3. The program also obtains the real and imaginary parts of the roots, and performs certain auxiliary computations described in the documentation. If in addition to the coefficients A_1 and A_3, we specify a set of positive real numbers, we may consider the set of equations

$$Z^3 + \delta_\ell A_1 Z^2 + Z + \delta_\ell A_3 = 0, \qquad \ell = 1,2,\ldots,L.$$

The program computes the roots of each cubic equation in this set. It then prints a table of the results giving the coefficients, discriminant and roots of each of the equations. These calculations assist the researcher in understanding how the nature of the roots changes as the multiplier δ is varied.

TITLE: Ephemeris Data Plot
AUTHOR: Crowley, P.

INITIATOR: Sagalyn, R. (LIF)
PROJECT: 8617 PROBLEM NO. 1257

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 20_8k

Three programs process and plot Mode 1 and ephemeris data from Experiment 12 on the OGO-A satellite.

The first program reformats the Mode 1 data tape to reflect the actual day on which data was collected.

The second program reformats the satellite altitude tape. Certain variables that include information about universal and local time, velocity, field strength, height, latitude, longitude, etc., are selected from the original tape and output on a new tape.

The third program merges the tapes output from the two above programs and produces a pen-and-ink plot of density vs L-parameter, magnetic latitude, universal time and local time.

TITLE: Electron Density Data Plot
AUTHOR: Fioretti, R.

INITIATOR: Ulwick, J. (LIJ)
PROJECT: 7663 PROBLEM NO. 1258

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 21_8k

The OV3-2 satellite was launched from the Pacific Missile Range, Vandenberg Air Force Base, on 28 October 1966. This problem was part of a study to determine the aspect of the axis of the OV3-2 spacecraft and several probe vectors perpendicular to this axis.

The OV3-2 satellite Standing Wave Impedance Probe (SWIP) plot program was written to display the SWIP tape-recorded data under a particular format. This format was chosen to make the data compatible with the Retarding Potential Analyzer (RPA) final plot format for data comparison. Electron densities are displayed along with various satellite ephemeris and aspect parameters.

TITLE:	Pattern Recognition	
AUTHOR:	Conway, E.	
INITIATOR:	Glucksman, H. (LRL)	
PROJECT:	4641	PROBLEM NO. 1259
HARDWARE/SOFTWARE:	IBM 7094 II - 7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	14_8k	

As a new approach to solving the problem of pattern recognition of alphabetic characters, this program was written to test the method of piecewise linear separation of the characters. Patterns are classified according to certain recognizable characteristics, no matter what style or degree of clarity, and the program determines to what category (letter) the pattern conforms.

Piecewise linear separation is different from conventional methods of classification in that no hyperplanes are set up to distinguish between patterns belonging to the same category.

TITLE:	Image Processing	
AUTHOR:	Armstrong, D.	
INITIATOR:	Smith, J. (LII)	
PROJECT:	5628	PROBLEM NO. 1260
HARDWARE/SOFTWARE:	PDP-1; IBM 1460; IBM 7094 II-7044 DCS/Fortran IV, MAP	
MINIMUM CORE SIZE:	70_8k	

The PDP-1 computer is limited in both its memory size and speed to handle efficiently the many techniques of picture processing. This program was written to convert data generated on a PDP-1 to the IBM 7094 II-7044 DCS. Given a magnetic tape containing data points representing the light intensities of pictures, the DCS program converted the characters and allowed for storage and retrieval of different frames of the image. The program was capable of processing any portion of a picture defined by lines and points allowing for updating, comparing and smoothing.

This program was written in a manner flexible enough to add several new routines for picture processing to the system with minimal change to the program.

TITLE:	Speech Control Synthesizer Data Display	
AUTHOR:	Boudreau, R.	
INITIATOR:	Hill, M. (LRS)	
PROJECT:	5628	PROBLEM NO. 1261
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV	
MINIMUM CORE SIZE:	30_8k	

The process of visually displaying data of speech utterances recorded via a speech control synthesizer was automated.

Data from various types of input is generated by the synthesizer on magnetic tape, which is then used in conjunction with program "SCC" to generate plots which compare amplitudes and frequencies of the input data. The input normally consists of 13 variables, from which 6 plots are presented.

The horizontal axis consists of units of time, where one centi-second equals one time unit. Variable-length input data is allowed, and a different plot symbol is used for each file of input data. This data is also output in a table.

TITLE:	Spectral Estimate of Ionospheric Irregularities	
AUTHOR:	Grossbard, N.	
INITIATOR:	Elkins, T. (LIR)	
PROJECT:	4643	PROBLEM NO. 1262
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV, Map	
MINIMUM CORE SIZE:	77_8k	

Power spectra, auto-correlation and cross-correlation functions of satellite signal fading data were computed in order to estimate the spectra of the ionospheric irregularities which cause the signal fading as well as their drift velocity.

The data was recorded on geo-stationary communication satellites.

The power spectra was calculated using the Fast Fourier Transform (Cooley-Tukey) method of determining Fourier power coefficients.

TITLE: OV3-2 Electrostatic Analyzer Data Processing
AUTHOR: Hussey, E.M.

INITIATOR: Ulwick, J. (LIJ)
PROJECT: 7633 PROBLEM NO 1263

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 55_8k

This program was written to reduce data recorded by the Electrostatic Analyzer experiment carried aboard the OV3-2 satellite.

Two electrostatic analyzers measure the flux and angular distribution of electrons. Positive and negative voltages applied to the two plates on each ESA and sweep determine the energy of the electrons.

For the data reduction, curves are drawn as a function of time through the monitor values and temperature values. Energy, current, and flux values are determined by applying the coefficients for the four monitor values. The time, energy, current and flux values are listed and plotted.

TITLE: Electromagnetic Field Study
AUTHOR: Kim, K.

INITIATOR: Shore, R. (LZE)
PROJECT: 5635 PROBLEM NO. 1264

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 20_8k

The purpose of this study was to calculate numerically integrals of complex Bessel and exponential functions for a problem encountered in electromagnetic field studies. Ralston's quadrature method of integration was employed. This quadrature method gives highly accurate results since it uses Gaussian techniques in the interior of each subinterval and uses abscissas with weights of equal magnitude and opposite sign. In this way, when the subintervals are put together, only the end-points of the whole interval of integration remain.

TITLE: 1967 Atmospheric Optical Attenuation Model
AUTHOR: Hoffman, R.

INITIATOR: Elterman, L. (OPA)
PROJECT: 7670 PROBLEM NO. 1265

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 3_8k

This program was written to aid in the derivation of a model of a clear standard atmosphere for determining attenuation in the ultraviolet, the visible and infrared windows.

The derivation is based on a Rayleigh atmosphere combined with aerosol and ozone components. The format of the model is a series of tabulations for 22 wavelengths with Rayleigh, aerosol and ozone components arrayed at kilometer intervals to an altitude of 50 kilometers. Exploratory calculations pertaining to horizontal, vertical and slant-path transmission from sea-level, transmission between two altitudes and transmission to space are readily made from the tabulations.

TITLE: Atmospheric Attenuation Calculation and Plot
AUTHOR: Grossbard, N.

INITIATOR: Joss, J. (LYW)
PROJECT: 6672 PROBLEM NO. 1266

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 65_8k

Reflectivity and attenuation data, measured by three vertically pointing radars, was checked against the 30th channel, which was assumed to be noise.

The results consisted of absolute reflectivity values for the three wavelengths. The wavelengths were chosen such that the signals of the first radar were strongly attenuated, the second were weakly attenuated, and the third were unattenuated.

Nine graphs, consisting of the measurements of the verticals, attenuation, and time, each plotted vs the others, were generated as well.

TITLE: Mossbauer Spectroscopic Data Analysis
AUTHOR: Lonergan, F.

INITIATOR: Capone, B. (LQO)
PROJECT: 5621 PROBLEM NO. 1267

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 60_8k

Raw data, accumulated in the storage banks of the Mossbauer Spectrometer, is transferred to paper tape, converted to punched cards and plotted as a normalized curve of channel number vs absorption. Normalized data is punched onto cards and used in a curve-fitting program to produce a Lorentzian reference curve in comparison with the normalized data curve.

A Calcomp plot of velocity per channel vs absorption is produced. The results will be used in the determination of positions of impurities in crystals.

TITLE: Electrostatic Analyzer Experiment Data Reduction
AUTHOR: Hussey, E.M.

INITIATOR: Toolin, R. (OPA)
PROJECT: 7621 PROBLEM NO. 1268

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 55_8k

Data from the positive and negative electrostatic analyzer (ESA) experiments carried on the OV3-2 satellite is reduced. The data is converted to current, energy, and flux, and temperatures are determined.

Output consists of a listing of (1) energy polynomial coefficients used to fit curves to energy data, (2) temperature in degrees centigrade, (3) ephemeris data, consisting of latitude, longitude, altitude, range time, and local time, (4) calculated data, including elapsed time, energy, current, and flux values determined by two different functions, (5) integrated data, consisting of energy KEV, log (flux), integral of energy integral, flux, and slope of the energy line, (6) noise and current averages for ESA-1 and ESA-2.

Plots of energy vs log (flux), both positive and negative, are also output.

TITLE: Least-Squares Fit Subroutine - General
AUTHOR: Spuria, A.

INITIATOR: Kahan, A. (LQO)
PROJECT: 5620 PROBLEM NO. 1269

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 2_8k

Subroutine "POLYNO" is a general mathematical routine which performs a least-squares fit for a set of points.

The "least-squares" method assumes that the best-fitting line is the one for which the sum of the squares of the vertical distances of the points for the line is a minimum. In other words, the set of points is fit to a curve.

Weights may be applied to the data if some of the data is less accurate (for example, near the ends of the interval of approximation).

TITLE: Power Spectral Analysis - Night Glow Data
AUTHOR: Grossbard, N.

INITIATOR: Rosenberg, N. (LKA)
PROJECT: 7661 PROBLEM NO. 1270

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 70_8k

Several programs were written to perform Fourier analysis on "night glow" input data equally spaced but having many values missing. The data consisted of daily readings of "night flow" at a specified frequency. A technique was devised to form the auto-covariance function, ignoring the missing data points.

The Fast Fourier Transform of Tukey was employed to find a graph of power vs frequency, and the power vs period was calculated for a range of periods.

An error analysis was performed on the results using the data with missing points, including a technique of inserting "random" numbers for the ordinates of the original data.

TITLE: Theoretical Analysis of Parabolic Mirror
AUTHOR: Tsipouras, P.

INITIATOR: Field, W. (LQP)
PROJECT: 5620 PROBLEM NO. 1271

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 30_8k

A theoretical analysis of the optical perfection of a shoot-focus parabolic mirror was performed. The study utilized the symmetrical characteristic of the ronchigram.

The parameters used in the analysis were such values as the focal length of the mirror, the grating spacing, the distance from the center of the mirror to the grating, the sagitta of the mirror, the ronchigram line/space factor and the radius of the mirror. The results consisted of the line number, the polar distance from the optic axis to a point on the mirror, the distance from the grating line to the optic axis measured at angle θ to the horizontal, the polar coordinates of a point on the ronchigram, and the cartesian coordinates of a point on the ronchigram.

In addition, the error (ΔS) between the theoretical value (Sp) of the distance from a point on the mirror to a plane normal to the optic axis and through the vertex and the experimental value (Se) was determined for evaluation.

TITLE: Analytical Solutions of the Three-Body Problem
AUTHOR: Grossbard, N.

INITIATOR: Jasperse, J. (LQR)
PROJECT: 5621 PROBLEM NO. 1272

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV, Formac, MAP
MINIMUM CORE SIZE: 72_8k

The problem of finding the wavefunctions and energies for the bound-states of atoms, molecules and ions is of central importance to the quantum chemist and also to the solid-state physicist who wants a quantitative understanding of the physical properties of dilute impurities in crystal lattices. Thus, new mathematical techniques for treating simple atoms, molecules and ions are being studied.

Involved in this study is the investigation of the bound-state, three-body problem with Coulomb pair interactions, which can be reduced to an infinite set of homogeneous algebraic equations for the energy eigenvalues and the associated eigenvectors. Eight simultaneous equations with eight unknowns are solved by a series of programs. The coefficients of the linear equations are given in terms of derivatives of a kernal. There are two parts to the problem. One part involves the generation of certain parameters by differentiation, using the Formac language. The second part involves the solution of the homogeneous algebraic equations.

TITLE: Pinch Effect in Plasma
AUTHOR: Dieter, K.

INITIATOR: Eckhardt, D. (LWG)
PROJECT: 8607 PROBLEM NO. 1273

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV, MAP
MINIMUM CORE SIZE: 28_8k

A mathematical model has been established to describe the collapse of a plasma (high-temperature gas composed of electrons) due to the intense magnetic field set up by the rapid motion of the electrons themselves. The model reduces to a non-linear differential equation which cannot be solved analytically; hence the need for a numerical approach.

The program solves this differential equation for various parameter values and plots out the results on a single pair of axes, so that comparisons can be made readily.

TITLE: Lunar Laser Residuals
AUTHOR: Grossman, P.

INITIATOR: Eckhardt, D. (LWG)
PROJECT: 8607 PROBLEM NO. 1274

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 35_8k

A paper tape generated by the lunar laser is read. Pre-editing is performed to eliminate all non-numeric data. Then the data is checked to determine if it is within the required limits, and if not, the entire record is rejected. The time observation is determined, and a table of calculated travel times is maintained. The values needed for Lagrangian interpolation are extracted from this table.

The edited data will be written on disc, magnetic tape, or cards. The ephemeris data and multiple-point Lagrangian interpolation are used to calculate the residuals of measured laser beam travel time minus the calculated laser beam travel time. Day, hour, minutes, seconds, start time, calculated travel time, measured travel time, measured-calculated, half-width center and card number are printed.

TITLE: Three-Body Problem with Attractive Potentials
AUTHOR: Tsipouras, P.

INITIATOR: Eyges, L. (LQD)
PROJECT: 5621 PROBLEM NO. 1275

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 42_8k

The Schröedinger equation is a second-order partial differential equation which describes many problems arising in the physics of atoms, molecules and crystals. The three-body problem with attractive potentials involves the solution of Schröedinger's equation for three particles for its eigenvalues and eigenvectors. This solution provides all the observable physical information about these systems. The method of solution is the approximation of the integral with a set of linear equations, using Simpson's Rule for integration.

TITLE: Multiple Regression Analysis
AUTHOR: Mandell, C.

INITIATOR: Lund, I. (LKI)
PROJECT: 8624 PROBLEM NO. 1276

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 100_8k

A minimum number of effective predictors was selected from a set of variables for computation in a multiple regression equation. At each step, partial correlations were examined and the variable giving the highest coefficient was chosen. The pro cedures were repeated until a selected predictor failed to explain a "significant" additional percentage, or until a prespecified number of predictors had been selected.

At the end of the selection procedure, a set of regression equations was computed, and the standard error of each regression coefficient was also computed.

TITLE: Cubic and Quartic Equation Solutions
AUTHOR: Kafatou, T.

INITIATOR: Tsipouras, P. (SUYA)
PROJECT: 0001 PROBLEM NO. 1277

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 50_8k

Two subroutines were written to provide solutions for abstract mathematical problems encountered by mathematicians and engineers.

One subroutine solves any cubic equation with real coefficients when the coefficients are given. The real as well as the complex roots are fo' ' ·ıd the polynomial value ror the roots is also given as a check fcr accur~

The second subroutine solves any fourth-degree equation w'th real coefficients when the coefficients are supplied. The same procedure described for the cubic subroutine is followed in the solution of the quartic equation.

TITLE: ION Production Tables
AUTHOR: Delaney, W.

INITIATOR: Toman, K. (LII)
PROJECT: 5631 PROBLEM NO. 1278

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 12_8k

Several ION production tables containing data that are functions of solar zenith angle were given. The initial solar zenith angle, the decreasing interval between readings, a weighting factor, the height, and an additive constant were supplied with each set. All of the separate tables were combined into one, using the factors assigned, and the results were printed and punched out on cards.

The following equation was used to compute the final output table:

$$T(X) = T(X_1)K_1 + T(X_2)K_2 + \dots T(X_n)K_n + K.$$

TITLE: Correlation of Reflectivity and Attenuation
AUTHOR: Grossbard, N.

INITIATOR: Joss, J. (LYW)
PROJECT: 6672 PROBLEM NO. 1279

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 65_8k

Two programs perform correlation of reflectivity and attenuation measured by three vertically pointing radars.

The three radars are of different wavelengths and are sampled in sequence at 30 ranges. The data is recorded on digital tape.

At first, N successive samples of a given range are averaged. Then, only the signals being significantly above noise are processed and corrected for range. The results thus obtained consist of absolute reflectivity values for the three wavelengths, which are chosen so that the signals of the first radar are strongly attenuated, of the second one are weakly attenuated, and of the third are unattenuated.

Regression analyses are made between reflectivity and attenuation for different altitudes (ranges). Results are plotted.

TITLE: OV1-9 Data Merge
AUTHOR: Hackett, J.

INITIATOR: Smart, D. (PHE)
PROJECT: 8600 PROBLEM NO. 1280

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 23_8k

Digital data tapes generated from the OV1-9 satellite experiments were examined, processed and merged with ephemeris data.

The data tapes created from this experiment contained four files of information per single orbit of the satellite. Each file represented four IRIG channels (12, 15, 16, 17); however, only channel 15 and 17 were of interest. These two files were merged together according to GMT seconds.

Since the telemetry data was recorded every second during orbit and the ephemeris data was given for each minute of orbit, the latter information was interpolated linearly to yield ephemeris data for each second.

The output resulting from the merging of the telemetry data tape and ephemeris tape consisted of ephemeris data, channel 15 data and channel 17 data for each second of GMT.

TITLE: Static Susceptibility of Quantum Gas
AUTHOR: Persakis, T.

INITIATOR: Prasad, B. (PHD)
PROJECT: 8608 PROBLEM NO. 1281

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 30_8k

A function is evaluated for the purpose of studying the static susceptibility of quantum gas.

The function,

$$F(Z) = \frac{a}{6\pi Z^2 X}\left[\sqrt{1+X^2} - 4Z^2 x \ln(X+\sqrt{1+X^2}) + \sqrt{1+X^2}\left\{\frac{3}{2}Z + \frac{1}{2Z} - \frac{1}{2X^2}\right\} \ln\left|\frac{1-Z}{1+Z}\right| + \left(\frac{1}{X^2 Z} - 2Z\right)(1+X^2Z^2)^{1/2}\left\{\ln\left|\frac{1+Z}{1-Z}\right| + \ln\frac{1+ZX^2 - \sqrt{1+X^2}\,\sqrt{1+X^2Z^2}}{1-ZX^2 - \sqrt{1+X^2}\,\sqrt{1+X^2Z^2}}\right\}\right]$$

is evaluated in single precision. $F(Z)$ represents the susceptibility of the gas, and $0 < Z \leq 1$ in steps of 0.01, where $Z \sim \frac{\text{wave number}}{\text{fermi momentum}}$ and X is the relativity parameter.

The curve of $F(Z)$ vs Z at the interval 0.01 is output on a Calcomp plot.

TITLE: Calculation of Doppler Shifts
AUTHOR: Birtwell, R.

INITIATOR: Klobuchar, J. (LIR)
PROJECT: 4643 PROBLEM NO. 1282

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 35_8k

"DOPPLER" calculates Doppler shifts of a given frequency and altitude from changing latitudes and longitudes. Input consists of punched cards containing heights, latitudes, longitudes, frequencies, and time parameters. The output consists of a printed listing of the Doppler shifts.

TITLE: Least-Squares Plot
AUTHOR: Delaney, W.

INITIATOR: Culp, G. (OPR)
PROJECT: 8658 PROBLEM NO. 1283

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 7_8k

Given eight sets of data as input, the program calculated the rotational temperature, computed the best linear least-squares fit through the eight sets of raw data points, found the X,Y intercepts from the least-square analysis, and calculated the standard deviation of the estimated best fit of the rotational temperature. The results were plotted using the Calcomp pen-and-ink plotter.

TITLE: Polarization Properties of Infrared Beamsplitters
AUTHOR: Atkinson, J.

INITIATOR: Loewenstein, E. (OPI)
PROJECT: 7670 PROBLEM NO. 1284

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 36_8k

The program written under Problem No. 1502, which calculates the energy throughput of an interferometer for the case where an unsupported thin film is used as beamsplitter, is modified to read in a table of values of n, which represents the index of refraction of the thin film, and α, the angle between the normal and the ray inside the thin film, as a function of wavenumber. The terms n and α were used as constants in Problem No. 1502, and in this problem a quadratic interpolation scheme is used to arrive at the correct values of n and α.

TITLE:	Initial ISIS Data Processing	
AUTHOR:	Fox, J.	
INITIATOR:	Sagalyn, R. (LIF)	
PROJECT:	8617	PROBLEM NO. 1285
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV	
MINIMUM CORE SIZE:	64_8k	

Three programs were written to assist in the processing of telemetry data obtained on the spherical electrostatic analyzer flown on the ISIS-A satellite. This data on a preprocessed magnetic tape is unpacked, sorted, converted to volts and plotted by the first program.

The second program summarizes the preprocessed telemetry data by listing ephemeris data and calculating geomagnetic local time every 60 seconds.

The third program reads a non-Fortran binary tape containing ephemeris data and two channels of experiment data in packed form. The experiment data is unpacked, converted from counts to volts, and identified and separated into three modes of operation. In-flight calibrations are applied to the three modes of data to convert output voltages to log current. Flux and density calculations are applied to the mode 1 log current data to produce CRT plots.

Modes 2 and 3 data are written on an output tape in binary form for later processing by the user.

TITLE:	Development of Mathematical Filters	
AUTHOR:	Grossbard, N.	
INITIATOR:	Hicks, F. (LWL)	
PROJECT:	7600	PROBLEM NO. 1[illegible]36
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV, Map	
MINIMUM CORE SIZE:	65_8k	

Several programs were written to develop mathematical filters for the purpose of filtering the initial flight data for the Gravity Harvest Data Reduction System. The filtering will smooth the data in order to yield a better representation of the real parameters.

The rationale behind the filtering methods is basically the following. The Fourier analysis of the actual phenomenon that the program is measuring has some general properties. The "noise" upon the data has a Fourier analysis which has some general properties different from the Fourier analysis of the actual phenomenon. Investigation of both Fourier analyses allows for the modification of the measured data to be a better measure of the actual phenomenon being studied.

TITLE: Thermosphere Composition Evaluation
AUTHOR: Russell, J.

INITIATOR: Hunt, W. (LKB)
PROJECT: 8605 PROBLEM NO. 1287

HARDWARE/SOFTWARE: Not Applicable
MINIMUM CORE SIZE: Not Applicable

Mathematical analysis of an integral equation of the convolution type is performed, and no computer programming was involved.

The analysis is employed in reference to evaluating densities and composition in the thermosphere.

The integral equation has the form,

$$N_{MAX} e^{-(t-t_N)^2/S_N^2} = \int_{-\infty}^{\infty} I_{MAX} e^{-(t'-t_I)^2/S_I^2} S(t-t')dt'$$

TITLE: "Quiet Day" Curve
AUTHOR: Delaney, W.

INITIATOR: Cormier, R. (LII)
PROJECT: 5631 PROBLEM NO. 1288

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 22_8k

Riometer readings of amplitude at equal time intervals were plotted to determine a "quiet day" curve.

The monthly diurnal variation of absorption was determined from a year's riometer data.

TITLE: Quadrature of Experimental Data
AUTHOR: Grossman, P.

INITIATOR: Toman, K. (LII)
PROJECT: 5631 PROBLEM NO. 1289

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 70_8k

Experimental data consisting of path length derivatives with respect to time is adjusted and scaled. The data is inverted about the "zero line," and quadrature is performed.

The original function and the resulting integral are plotted on both a small and large scale.

The output plots of the experimental data may be compared with the theoretical results generated by Problem No. 1554.

TITLE:	Frequency of a Fringe Maxima
AUTHOR:	Delaney, W.
INITIATOR:	St[illegible]ka, R. (LIR)
PROJECT:	5[illegible] PROBLEM NO. 1290
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	2_8k

Two tables of frequencies in MHZ of fringe maxima were prepared, based on the solution of two different equations.

This effort was in connection with a radio frequency evaluation. Given parameters to the program include the lobe number, solar declination in degrees and the time in minutes after meridian passage of the sun.

TITLE:	Monostatic Reflection
AUTHOR:	Whelan, L.
INITIATOR:	Toman, K. (LII)
PROJECT:	5631 PROBLEM NO. 1291
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	45_8k

Modifications were made to Problem No. 1554, which simulates the behavior of the path length for a radar reflection from a perfect sinusoidal ionospheric wave.

A technique was introduced to guarantee that all the solution points for the specular reflection problem are found for the purpose of computing the focusing effects at the specular reflection points.

A plot of the absolute value of the vector sum of electric field strength vs time was added.

Also, two subroutines were included to (1) compute at each solution point the signed amplitudes returned from the wave speculum with its vector direction, and (2) sum these signal amplitudes vectorially and construct a matrix of absolute values of the sums for plotting purposes.

TITLE: OV3-1 and OV3-2 Satellite Data Handling
AUTHOR: Dalton, L.

INITIATOR: Kuck, G. (PHE)
PROJECT: 8600 PROBLEM NO. 1292

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 21_8k

A general plot program was written in order to display data recorded on the OV3-1 and OV3-2 satellites after the data was merged with ephemeris data. Plots can be obtained of any parameter in the file vs time of flight.

Other options available to the user are as follows:

a. Any size plot can be generated.

b. The points per inch for the X and Y axis can be varied.

c. Variable titles for the plots can be input.

d. Noisy data can be filtered.

TITLE: OV Merge Tape Data Listing
AUTHOR: Fusco, R.

INITIATOR: Sagalyn, R. (LIF)
PROJECT: 8617 PROBLEM NO. 1293

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 12_8k

"LISTALL" is designed to list out any data point contained on the OV Satellite series merge tapes.

The program is able to provide the capability of accessing experimental data pins from a merge tape. There are a number of options available for the listing of any OV series merge tape, such as, (1) variable input record size, (2) multiple file processing and (3) variable selection of data plus pins for listing.

TITLE:	Gemini D-10 Experimental Data Processing
AUTHOR:	Pruneau, P.
INITIATOR:	Sagalyn, R. (LIF)
PROJECT:	8617 PROBLEM NO. 1294
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	6_8k

This effort was part of the program system used to process the data from the Gemini D-10 experiment, which was flown on the Gemini Spacecrafts 10 and 12.

The Gemini ephemeris data is merged with assigned experiment data words. The ephemeris words are interpolated, since the time interval between ephemeris data points was longer than the time interval between experiment data points.

Assigned ephemeris data and densities are plotted vs Gemini Elapsed Time (GET) in total seconds after launch.

Conversion functions are performed to obtain current values originally in volts, and using the currents and angles focused, to calculate densities.

Finally, assigned experiment data pins and yaw, pitch and roll angles are plotted vs Gemini Elapsed Time in total seconds after launch.

TITLE:	Sunshine Data Table
AUTHOR:	Armstrong, D.
INITIATOR:	Lund, I. (LKI)
PROJECT:	8624 PROBLEM NO. 1295
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	63_8k

Sunshine data was recorded on magnetic tape at ten different stations across the country for the years 1905 to 1962. One observation per day was recorded. A table of the average sunshine for each month is printed. In addition, the Boston station contains data recorded from 1894 to 1962.

TITLE:	Scaling Sets of X-Ray Intensity Data
AUTHOR:	Harris, S.
INITIATOR:	Yannoni, N. (PHF)
PROJECT:	8659 PROBLEM NO. 1296
HARDWARE/SOFTWARE:	IBM 1'6C, IBM 7094 II-7044 DCS/F rtran IV, MAP
MINIMUM CORE SIZE:	77_8k

Two programs were converted from Fortran II and FAP to Fortran IV and MAP for use on the DCS.

Program "DIFCOR" calculates the best scale factors for overlapping sets of intensity data, applies these scale factors and computes average intensities. The scale factors are computed by a least-squares method which minimizes a sum of residuals linear in the logarithms of the scale factors. This procedure converges in one cycle. The resulting scale factors are then applied in a second pass at the data, and average intensities are computed.

Program "TAPSET" produces the control tape for operation of an automated Super-Pace Diffractometer.

TITLE:	Calculation of Model Densities
AUTHOR:	Dieter, K.
INITIATOR:	Schweinfurth, R. (LKB)
PROJECT:	6690 PROBLEM NO. 1297
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	70_8k

A program written under Problem No. 1593 aids in the study of the relationships among geomagnetic index, solar flux, and the ratio of certain statistical quantities as a function of time. The observational data is compared with a model developed from theoretical considerations. The computer output helps to display the degree of correlation between theory and experiment.

The program written under this problem number is a version of Problem No. 1593. The plotting has been confined to just one array vs time. The modifications involve the drawing of an axis (for time) which is more aesthetically satisfying than the one drawn by the system subroutine. A different set of symbols for designating points on the curve is also employed in this version.

TITLE: Satellite Position
AUTHOR: Kim, K.

INITIATOR: Tsipouras, P. (SUYA)
PROJECT: 0001 PROBLEM NO. 1298

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 14_8k

Primarily the distance of a satellite above the horizon and its distance from the horizon plane were determined from data input on magnetic tape. The input includes the satellite position, modified Julian date, calendar date, subsatellite latitude and the time interval for the aforementioned data.

Some of the parameters computed by this program are: the probing height, the solar zenith angle at place of satellite, distance of satellite from the horizon plane, reference value of earth radius for the satellite, earth flattering factor, reference value of earth radius under the probing point, geocentric latitude of satellite subpoint and geocentric latitude of probing point.

TITLE: Phase Interference Filters
AUTHOR: Doherty, R.

INITIATOR: Kriger, L. (LRS)
PROJECT: 4610 PROBLEM NO. 1299

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 24_8k

The overall impulse and step response functions of phase interference filters at discrete time intervals were computed as well as the real roots of a quintic equation (fifth-degree polynomial) with variable, real coefficients.

First, the two-impulse and two-step response functions of phase interference filters are calculated and the impulse functions and step response functions are combined algebraically to give the overall function solutions tabulated at discrete time intervals.

Then, the real roots of a fifth-degree polynomial with variable coefficients are calculated by use of the false-positioning routine. Output consists of a listing of root solution, polynomial value at this root, program identification, and equation identification.

Finally, all five roots of a fifth-degree polynomial with variable, real coefficients are computed by using the Birge-Vieta iteration method. Output consists of program identification and intermediate results of the iterative root-finding process, as well as the complete list of roots with real and imaginary parts displayed separately.

TITLE: Upper Atmospheric Wind Studies
AUTHOR: Doherty, R.

INITIATOR: Zimmerman, S. (LKC)
PROJECT: 7667 PROBLEM NO. 1300

HARDWARE/SOFTWARE: Not Applicable
MINIMUM CORE SIZE: Not Applicable

A numerical technique is used in the analysis of a first-degree, first-order, nonhomogeneous differential equation.

The analysis was developed to assist physicists in interpreting upper atmospheric wind conditions, using a mathematical model.

A first approach to the problem was to estimate first and second derivatives by finite differences. This approach can give reasonable results only if the function values are known at closely packed points.

A more refined approach was to use a Runge-Kutta method to estimate the derivative. It gives a better approximation but does not alleviate the problem of the sensitivity of the approximation of the auxiliary functions.

No computer programming was involved in this study.

TITLE: Evaluation of Cutoff Rigidities
AUTHOR: Pustaver, J.

INITIATOR: Smart, D. (PHE)
PROJECT: 8600 PROBLEM NO. 1301

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 30_8k

Galactic cosmic rays approach the earth from all directions of space. When these particles reach the earth's magnetic field, their trajectories are altered a great deal, depending upon the particle's energy and charge, the direction of approach to the magnetosphere, and the magnetic field strength and configuration.

In considering the trajectory of a given particle, it is convenient to consider momentum and charge as a single quantity, called the particle's "rigidity," which is the ratio of momentum per unit charge. All particles having the same rigidity, if entering the magnetic field at the same place and angle, will follow the same path. The trajectories of charged particles have been used primarily in the study of vertical "cutoff rigidities," defined as the lowest rigidity a particle may possess and still arrive at a specific point on the earth's surface from the vertical direction.

A computer program was written to aid in the study of these cutoff rigidities by computing, by interpolation, the cutoff rigidity at any point on the earth's surface.

TITLE: Tape Regeneration
AUTHOR: Dabcovich, M.

INITIATOR: McInerney, R. (SUYA)
PROJECT: 0001 PROBLEM NO. 1302

HARDWARE/SOFTWARE: IBM 1460/Autocoder
MINIMUM CORE SIZE: 10_8k

When large amounts of data on magnetic tapes are received from outside sources, there is usually a hardware compatibility problem. Usually the first tape error encountered halted operations on the DCS system. The tape copy utility programs that were available for use on the DCS were also limited in the same manner. Thus, it became practically impossible to read a tape with several errors.

The two programs written for this problem number were used as a preliminary step to copy every incoming data tape. One program accepts and copies constant length records, and a second version accepts sh t records.

TITLE: Spatial Variability of Temperature Studies
AUTHOR: Chin, J.

INITIATOR: Gringorten, I. (LKI)
PROJECT: 8624 PROBLEM NO. 1303

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 33_8k

A study was conducted to determine at which height supersonic aircraft would perform at peak efficiency using a minimum amount of fuel.

Since it is felt that temperature directly affects the performance and fuel consumption of supersonic aircraft, the study centered on temperatures at the 30 mb, 50 mb and 100 mb levels.

The data used was collected on a daily basis for a period of two years from 1977 stations across the northern hemisphere.

The spatial variability of temperature on a constant pressure surface was computed by comparing the 3-, 6-, and 12-station minimum temperatures.

Maps of 2- to 92- percentiles of temperature at each point of a grid that covers the northern hemisphere on a polar stereographic projection were created for three heights (30 mb, 50 mb and 100 mb) and each of four seasons (winter, spring, summer and autumn).

TITLE:	Evaluation of Fourier Coefficients
AUTHOR:	Doherty, D.
INITIATOR:	Lammers, U. (LZN)
PROJECT:	5635 PROBLEM NO. 1304
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	4_8k

The computer program "FCAL" was written to assist physical scientists in quickly calculating a number of coefficients of a Fourier series.

'FCAL" calculates ten coefficient terms of a Fourier series expansion for sixty-two different independent parameter values, presenting 620 terms in total. The program lists the independent parameter values used in each calculation and the calculated coefficients. Although the program is written to accommodate specific independent parameter values, it can easily be modified to accommodate other parameter values.

TITLE:	Radar Meteor Trail Set - Antenna Orientation
AUTHOR:	Littlefield, H.
INITIATOR:	Barnes, A. (LYU)
PROJECT:	8628 PROBLEM NO. 1305
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	17_8k

The best orientation of a meteor trail radar set at Eglin AFB in Florida was determined. Two programs which had performed this task for the AFCRL Radar Meteor Trail Set located in Durham, N.H., were converted to the DCS and then adapted to the task at hand.

The direction of the antennas depends on the azimuth giving the maximum count of sporadic meteors for the period of interest.

The program determines four response functions (N,S,E,W directions of the antennas) and determines the diurnal echo rate for different times of the year.

TITLE:	Autocovariance and Power Spectral Analysis
AUTHOR:	Harris, S.
INITIATOR:	Silverman, B. (LYP)
PROJECT:	7605 PROBLEM NO. 1306
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran II
MINIMUM CORE SIZE:	20_8k

Problem No. 1306 concerned converting "BMD02T," a running Fortran II program, to run on the 7044/7094 DCS at AFCRL. "BMD02T," Autocovariance and Power Spectral Analysis, computes the autocovariance, power spectrum, cross-covariance, cross-spectrum, transfer function and coherence function of time series.

Input options to the program include plotting the time series, detrending of the input series, prewhitening, plotting the power spectrum in linear or log scale or both, and several options for selecting the type of calculations desired.

TITLE:	Monthly Diurnal Variation of Absorption
AUTHOR:	Delaney, W.
INITIATOR:	Cormier, R. (LII)
PROJECT:	5631 PROBLEM NO. 1307
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	10_8k

The monthly diurnal variation of absorption is determined from a year's riometer data, as a modification of Problem Nos. 1023 and 1047. A procedure for generating a quiet day or reference curve was established to produce the envelope of the year's data scatter plot. This envelope is sampled every 12 minutes and punched on a card with the appropriate corresponding local sidereal time. This deck of cards is the reference cosmic noise curve for the period it covers.

The daily absorption deck (three cards per day) generated during computation of the QDC is then compared with the reference deck. The value of the daily deck is subtracted from the corresponding time of the reference deck. This corresponding time is translated into local standard time and plotted with the difference generated above.

TITLE: Energy Levels of the Ionized Hydrogen Molecule
AUTHOR: Ring, R.

INITIATOR: Jasperse, J. (LQR)
PROJECT: 5621 PROBLEM NO. 1308

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS; CDC 6400/Fortran IV
MINIMUM CORE SIZE: 110_8k

This study concerned the quantum-mechanical problem of one particle moving in the field of two identical fixed centers. An equation for the problem was derived in both position and momentum space as a special limiting case of the general method for the three-body problem. When applied to the H_2+ problem, using the Coulomb-Sturmian set as an expansion basis, the method gives an infinite secular equation for the energy eigenvalues, which can be solved exactly in the limits as the internuclear distance goes to zero and to infinity.

Several programs were written to calculate numerically the energy levels and coalescence constants for ionized hydrogen-like molecules in the fixed-nucleii approximation. Computations were made for various truncations of the aforementioned secular equation. The desired eigenvalues and their associated eigenvectors were computed and printed out.

TITLE: Evaluation of Quantum Mechanical Cross Sections for Electron Capture
AUTHOR: Doherty, R.

INITIATOR: Mapleton, R. (LKS)
PROJECT: 8627 PROBLEM NO. 1309

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 74_8k

"GAUSSL5" assists in a scientific investigation concerning spectroscopic studies by solving numerically a number of multiple integrals.

Cross-sectional absorption function values as approximated by multiple sums over a range of Gauss-Legendre points and weighted appropriately with Gauss-Legendre weights are calculated.

The purpose is to generate quantum mechanical cross-sectional values as a function of energy. The output consists of a list of pertinent values associated with the integrations.

TITLE:	Solar Flux Cross-Correlation and Auto-Correlation
AUTHOR:	Boudreau, R., and Dieter, K.
INITIATOR:	Barron, W. (LIR)
PROJECT:	5629 PROELEM NO. 1310
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS; CDC 6600/Fortran IV
MINIMUM CORE SIZE:	67_8k

The convolution theorem implemented by the first Fourier transform is used to compute the cross-correlation between different pairs of variates in order to detect any common periodicities in solar flux data.

Output is in the form of plots of cross-correlation coefficients vs lag for every pair of frequencies. For each case there are three plots corresponding to different maximum and minimum lags.

TITLE:	Analysis of Observed Solar Radio Flux and Burst Phenomena
AUTHOR:	Atkinson, J.
INITIATOR:	Barron, W. (LIR)
PROJECT:	5629 PROBLEM NO. 1311
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	40_8k

Investigation was made and analysis performed on solar events; for example, proton or neutron emissions and characteristics of the daily flux density from the sun. It was also desirable to find the effects, if any, of these events in space and also in our atmosphere.

The study involved analysis of the changes in individual daily fluxes, the relationship between certain events with specific sunspot activity and the variation of flux density with different level intensities of the sun.

The input flux level is plotted against the log of the frequencies of the observed flux levels.

TITLE: Correlation of Atmospheric Data
AUTHOR: Atkinson, J.

INITIATOR: Hawkins, R. (LYS)
PROJECT: 6698 PROBLEM NO. 1312

HARDWARE/SOFTWARE: IBM 7094 II- 7044 DCS/ Fortran IV
MINIMUM CORE SIZE: 71_8k

The object of program "COR MATRIX" was to correlate two sets of data; smoothed cloud readings vs nine sets of averaged radar indices at Tan Son Nhut for June, July and August of 1966 and 1969 according to corresponding geographical locations.

The program also will print out intermediate results of the correlation and regression calculations along with the repression equations if requested by the user.

The output is a series of grids giving correlation factors between radar indices and cloud readings at various time intervals.

TITLE: Calculation of Term Values of Rydberg Series
AUTHOR: Doherty, D.

INITIATOR: Takezawa, S. (LKS)
PROJECT: 8627 PROBLEM NO. 1313

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/ Fortran IV
MINIMUM CORE SIZE: 3_8k

The computer program "RY" was written to assist atomic physicists in quickly calculating a number of terms for a Rydberg series expansion.

"RY" calculates 31 terms of a Rydberg series for different independent parameter values and the negative consecutive differences of these 31 terms. The program lists the parameter values in each calculation and the individual term values. The program is written to accommodate 62 specific parameter values, but can easily be modified to accommodate other parameter values.

TITLE:	Contour Mapping
AUTHOR:	Boudreau, R.
INITIATOR:	Tsipouras, P. (SUYA)
PROJECT:	0001 PROBLEM NO. 1314
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS; CDC 6600/Fortran IV
MINIMUM CORE SIZE:	120_8k

Several programs were written to generate contour plots from data presented at either equal or random intervals. A maximum of 2500 input points and a maximum of 2500 grid points, where the user specified the fineness of the grid to be used, were allowed.

Data in polar coordinates which had been generated by measurements of the reflection and polarization characteristics of natural terrestrial materials could be produced in a contour plot as well.

The programs may be applied to any physical situation in which a contour has meaning.

TITLE:	A-D Tape Conversion
AUTHOR:	McInerney, R.
INITIATOR:	Maple, E. (PHG)
PROJECT:	8601 PROBLEM NO. 1315
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV, MAP
MINIMUM CORE SIZE:	21_8k

The on-site A-D converting equipment generates a digitized tape in a format not immediately usable with the DCS Operating System. Therefore, the "CVTCRL" routine was developed to convert non-Fortran First-pass A-D output tapes to a format more suitable for use with the IBM 7094/7044 DCS Operating System. It provides options to choose at execution time the input file and type of data to be converted, the method of normalization and the type of magnetic tape output desired.

"CVTVAN" is a modification of "CVTCRL" to convert part of a file when data files on the non-standard A-D input tapes are too large to unpack, reformat and record on one reel of tape.

TITLE:	Three Components of the Elastic Displacement Vector	
AUTHOR:	Doherty, R.	
INITIATOR:	Haskell, N. (LW)	
PROJECT:	7639	PROBLEM NO. 1316
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS; CDC 6600/Fortran IV	
MINIMUM CORE SIZE:	17_8k	

Three programs assist seismologists in numerically solving a number of double integrals. All three calculate discrete displacement values as a function of time as approximated by a double sum over a range of Gauss-Legendre points and weighted appropriately with Gauss-Legendre weights. The programs vary chiefly in the definitions of the integrands. The three components of the displacement function are described by double integrals over the dimensions of a model fault plane.

"INTEGAUSS2-LG" generates longitudinal displacement contours for several sets of input parameters, consisting of the coordinates of the field point at which the mathematical model is being evaluated; compressional and sheer wave velocities; and the dimensions of the fault plane.

"INTEGAUSS2-TR" generates transverse displacement contours for the several sets of input parameters, and "INTEGAUSS-TN" generates tensile displacement contours for the sets of input parameters.

The output data is stored on magnetic tape to be used as input to a plot and differencing program. (See Problem No. 1402.)

The three programs were written for the IBM 7044-7094 DCS; however, "INTEGAUSS-TN" has been converted to the CDC 6600.

TITLE:	Electron Distribution in Metal Slab	
AUTHOR:	Grossbard, N.	
INITIATOR:	Jasperse, J. (LQR)	
PROJECT:	5621	PROBLEM NO. 1317
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV	
MINIMUM CORE SIZE:	77_8k	

Three programs describe the electron distribution function within a slab of metal after it has been struck by either gamma or X-rays.

A set of linear equations derived as a difference-equation solution of an integral equation is solved, with an infinite sheet of metal being considered.

Then, the eigenvalue problem associated with the integral equations described above is solved.

Finally, a double integral equation is solved in order to describe the electron distribution function in an infinite strip of metal.

TITLE:	Binomial Probability For Fail-Safe Decoding		
AUTHOR:	Pustaver, J.		
INITIATOR:	Hobbs, C. (LRD)		
PROJECT:	4610	PROBLEM NO.	1318
HARDWARE/SOFTWARE:	PDP-8/Telcomp		
MINIMUM CORE SIZE:	2_8k		

The binomial probabilities associated with fail-safe error correcting codes for transmission of binary data are calculated.

The program computes the binomial probability

$$p(x) = \binom{n}{x} p^x(1-p)^{n-x}$$

for n = 7; x = 0 to 7

This work was in connection with the testing of a decoding algorithm which would be implemented once the equipment was manufactured.

TITLE:	Solar Radio Burst Data Processing		
AUTHOR:	Guarente, J.		
INITIATOR:	Barron, W. (LIR)		
PROJECT:	4643	PROBLEM NO.	1319
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV		
MINIMUM CORE SIZE:	17_8k		

"LINEUP" was written for the purpose of observing and listing solar burst data. The basic task involved was to list the data chronologically and to list the six channels beside it. If one of the odd channels is saturated, a conversion is used on its even counterpart to record the data. These channels represent frequencies ranging from 606 to 8800. The six channels and the corresponding times are output.

TITLE: Transformation of a Point in Space
AUTHOR: Delaney, W.

INITIATOR: Hadgigeorge, G. (LWG)
PROJECT: 7600 PROBLEM NO. 1320

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 13_8k

Right ascension and declination of a point in space are converted to elevation and azimuth from an observation station. Inputs consist of geodedic coordinates, right ascension in hours, minutes and seconds, declination in degrees, minutes and seconds and universal time of the observation.

The program performs the following operations:

a. Converts time to sidereal time.

b. Converts geodedic to geocentric latitude.

c. Computers local hour angle.

d. Computes elevation and azimuth.

TITLE: Fourier Analysis for Non-equally Spaced Data Points
AUTHOR: Grossbard, N.

INITIATOR: Almasian, R. (LKB)
PROJECT: 6690 PROBLEM NO. 1321

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 40_8k

A Fourier analysis of a set of nonequally spaced data points is made.

The program is useful for cases where either limited data (a few hundred points) or no physical model is available.

Two random data (Gaussian) samples are used in order to show what a "noise" sample looked like.

Cooley-Tukey fast Fourier analysis is used when equally spaced data exists.

The program produces power spectra for the data windows indicated as input options.

TITLE:	Solar Eclipse Calculations
AUTHOR:	Whelan, L.
INITIATOR:	Hussey, I. (SUYA)
PROJECT:	0001 PROBLEM NO. 1322
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS; CDC 6600/Fortran IV
MINIMUM CORE SIZE:	70_8k

Three DCS programs perform the task of predicting events associated with the solar eclipse of March 7, 1970.

Program "ETABLE" supplies the data to be input into the prediction program. This data, consisting of the right ascension of the sun and moon, declination of the sun and moon, radius of the sun, and the moon's parallax, is tabulated at one-minute intervals.

The output from program "SOLAR/LUNAR" of Problem No. 1131, consisting of obliquity at ecliptic and apparent longitude of the sun, is used with the "ETABLE" output as input to program "BESSEL."

"BESSEL" utilizes the ephemeris data tabulated on magnetic tapes as output of "ETABLE" and "SOLAR/LUNAR" to calculate Besselean elements at one-minute intervals for the solar eclipse.

These tabulated Besselean elements, consisting of information pertaining to position and measurements of the sun and moon during the eclipse, are used by "ECLIPSE" to provide, for a given observers' station, sun-moon contact time, information about the penumbral and umbral shadows at these times, and heliographic coordinates at the contact points.

A fourth program, written for the CDC, uses a standard occultation technique to determine immersion and emersion times of sunspots during the March 7, 1970, eclipse. The approximate heliographic coordinates of the sunspots, the geographic coordinates of the observer and certain tabulated ephemeris data for the eclipse are supplied in order to perform the calculations.

Magnetic tapes containing the tabulated ephemeris data and Besselean elements, and cards containing station information and sunspot heliographic coordinates, immersion times and emersion times are printed.

With slight modification, these programs may be applied to any eclipse if the appropriate ephemeris data is provided, and to any occultation by the moon of any point in the heavens.

TITLE: Electron Content Computation
AUTHOR: Greco, F.

INITIATOR: Sales, G. (LII)
PROJECT: 5631 PROBLEM NO. 1323

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 11_8k

A ground-based antenna system receives radio signals whose source is an orbiting vehicle. The system of receivers constitutes an interferometer, and the consequent phase variation contains an indirect measure of the electron content of the intervening ionosphere. Subject to the frequencies and antenna configuration used, non-ideal phase variations are manifest as doppler, refraction and Faraday (geomagnetic) effects.

Phase data is originally recorded on four-channel strip charts and is later converted to punched cards. "ELCON" accepts this input together with the element sets that prescribe the appropriate satellite phases and the set of magnetic constants, to generate separate estimates of electron content from theoretical formulations of these effects.

Subroutine "PHIP" reconstructs the phase amplitude measurements that are originally recorded on four-channel strip charts and later converted to punch card input decks. In order to maintain amplitude calibration and resolution, the strip chart data is recorded as sawtooth graphs. "PHIP" transforms these saw-tooth curves into equi-interval tabulations of phase amplitude versus time, generates composite channels, performs least-squares smoothing and maintains a time history on all channels.

TITLE: Matnematical Routines
AUTHOR: Tsipouras, P.

INITIATOR: Tsipouras, P. (SUYA)
PROJECT: 0001 PROBLEM NO. 1324

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 30_8k

Eight programs and subroutines which perform various mathematical functions were submitted for general use:

"C1P01" finds one real root of a given polynomial.

"C1P0I" finds the real roots of a polynomial.

"C1TE2," given the bounds of the roots, finds the real roots of a polynomial.

"C1L1D" fits a polynomial of degree "N" (double precision).

"C1L1S" fits a polynomial of degree "N" (single precision).

"MINVSP" solves the matrix equation Ax=B. The inverse of "A" is also obtained.

"C1MIX" performs a complex matrix inversion (single precision).

"C1GRA" makes a graph of a function.

TITLE: Three Components of the Near-Field Displacement Function
AUTHOR: Doherty, R.

INITIATOR: Thomson, K. (LWW)
PROJECT: 7639 PROBLEM NO. 1325

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 40_8k

First and second forward differences are generated for three components of the near-field displacement function, which was output in Problem No. 1316.

Divided differences (as derivative approximations) of time functions are computed and plotted for publication. A listing of the function values and their divided differences, correlated with time, is printed. The plot output consists of the three displacement functions and their first and second differences for each field point used.

TITLE:	Orbit Determination and Ephemeris Computation Applied to Laser		
AUTHOR:	Robinson, E.		
INITIATOR:	Cronin, E. (SUYA)		
PROJECT:	0001	PROBLEM NO.	1326
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV		
MINIMUM CORE SIZE:	77_8k		

Precise look angle computation was needed for satellites 899, 1328, 1726, 2674 and 2680 to enable laser acquisition of the satellites by the Geodesy and Gravity Branch. Precision oscillating elements were generated at Aerospace Defense Command, and were relayed to the Data Analysis Branch Orbital System. The elements were generated several hours before a satellite pass, and highly accurate look angles were generated for pointing the laser.

Precision position and velocity vectors were updated to two hours before the time of the satellite pass. Azimuth, elevation and slant range with respect to time are generated for the laser location.

TITLE:	OV1-86 Cosmic Ray Telescope Data Processing		
AUTHOR:	Cook, R.		
INITIATOR:	Katz, L. (PHE)		
PROJECT:	8600	PROBLEM NO.	1327
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV		
MINIMUM CORE SIZE:	26_8k		

A merge tape containing OV1-86 cosmic ray-charged spectrum telescope data is read and all possible events are selected. The program scales the hours, minutes and seconds for the latitude, longitude and altitude.

Output consists of printout and magnetic tape and includes hours, minutes, seconds in GMT, geocentric and geometric latitude and longitude, inclination, declination and temperature.

TITLE:	OV3-2 Plasma Probe Data Reduction
AUTHOR:	Sarris, G.
INITIATOR:	Sagalyn, R. (LIF)
PROJECT:	8617 PROBLEM NO. 1328
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	20_8k

Five programs were written to process data from the OV3-2 satellite for the plasma probe experiment.

"PAPRNT" selects from plasma probe data, returned from the OV3-2, any record which may represent a calibration event. In-flight calibrations are punched on cards to be input to "PAP."

"PAP" reads the 30-pin merged tape from OV3-2. A header record and the in-flight calibrations are read in prior to the normal data read. The data is separated into its respective mode, and if the mode data does not meet the tolerance requirements, the pre-flight calibrations are used to smooth the data. The PAP data, segregated by mode, is listed and output on magnetic tape for input to the three programs described below:

"MODE 1" processes the data output from "PAP." Each mode is subdivided into high and low energy. A series of plots display flux or density on a log scale versus elapsed seconds. Ephemeris data at varying time increments are illustrated above each group of related plots.

"MODE 2" inputs positive and negative analog voltages from the tape, and analyzes low and high energy ion and electron data. Voltages are converted to current and applied (actual) voltages. The resulting converted factors are then plotted in both linear and logarithmic fashion.

"MODE 3" measures differential energy distributions. The merged data, which represents analog voltages relating to the sweep and step voltage applied to the appropriate electrodes of either the positive or negative sensor periodically during the experiment is input from the tape. Output consists of the actual data to be plotted and off-line plots, each plot representing the average value of the current obtained during a given step versus the applied voltage.

TITLE:	OV5-1 Data Reduction		
AUTHOR:	Delmonico, R.		
INITIATOR:	Yates, G. (PHE)		
PROJECT:	8666	PROBLEM NO.	1329
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV, MAP		
MINIMUM CORE SIZE:	60_8k		

Calibration of data recorded on the OV5-1 satellite was accomplished by means of two subroutines. Calibration values are read and converted to a frequency range. There are 16 channels, with channel 8 being used as a subchannel. The program locks onto a channel 1 between 1195 - 1220 cycles frequency range, and searches for a channel 8.1. Channels 1 through 16 data is averaged and 90 average values per channel are received. The 60 median values of the data are printed.

TITLE:	Plot of Fuel Wave Input Data		
AUTHOR:	Persakis, T.		
INITIATOR:	Horowitz, S. (LII)		
PROJECT:	5631	PROBLEM NO.	1330
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV		
MINIMUM CORE SIZE:	26_8k		

The input data of a fuel wave computer program is plotted on CRT film. For comparison, file and identification purposes, a plot of electron density and collision frequency versus height was produced.

Also output is printing of identification of profile, starting height and the step, and the input variable E, which controls the way the values are read.

TITLE: Precision Pressure Gage Calibration Data
AUTHOR: Persakis, T.

INITIATOR: Smiltens, J. (LQP)
PROJECT: 5620 PROBLEM NO. 1331

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 14_8k

A least-squares fit for given data of a precision pressure gage calibration chart is performed.

The theoretical and experimental data, the residuals, the calculated tube constants A and B, and the standard deviation of errors are output.

TITLE: Photodissociation Rates for Oxygen and Ozone
AUTHOR: Doherty, D.

INITIATOR: Touart, C. (LY)
PROJECT: 8604 PROBLEM NO. 1332

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 7_8k

The computer program "PHOTO" was written to assist physical scientists in quickly calculating photodissociation rates for oxygen and ozone.

"PHOTO" calculates the photodissociation rates in various wavelength intervals at half-hour intervals from noon until sunset. The program was written to accommodate an unlimited number of input parameters representing different physical combinations of pressure, latitude, season and overlying masses of ozone.

The output is a listing containing independent parameter definitions and function values describing photodissociation rates.

TITLE: Relation of Wire Resistivity to Density
AUTHOR: Pustaver, J.

INITIATOR: Chace, W. (PHP)
PROJECT: 8608 PROBLEM NO. 1333

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 13_8k

Resistance and density of a wire which has been electrically "exploded" from measurements taken during the exploding process is calculated.

The purpose is to show the relationship between wire resistivity and density.

Listed as output are the calculations for the wire resistance at time "t," the wire resistivity at time "t," conductivity at time "t," density at time "t," and energy deposited at time "t."

TITLE: Theoretical Electromagnetic Wave Calculations
AUTHOR: Spuria, A.

INITIATOR: Jacavanco, D. (LZP)
PROJECT: 4642 PROBLEM NO. 1334

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 16_8k

Theoretical electromagnetic wave calculations were performed for comparison with experimental results.

A major consideration in this effort was the modification of a scientific Bessel function to evaluate functions for the complex variable. The routine was also adjusted to include an asymptotic approximation for the calculation of $J_0(\beta)$ and $J_1(\beta)$ when the magnitude of β was about 10 or larger.

TITLE:	Complex Roots of a Function		
AUTHOR:	Pustaver, J.		
INITIATOR:	Shickman, A. (PHD)		
PROJECT:	8647	PROBLEM NO.	1335
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV		
MINIMUM CORE SIZE:	17_8k		

A general mathematical routine was developed to find the complex roots of a complex function by using the Newton-Raphson method for solving a system of two equations in two unknowns.

The routine assumes that the value for which the function has a real root is known and is used as the starting point of the calculations. At each iteration that value is increased slightly and the previous root is used as the initial approximation.

TITLE:	Quantum Mechanics		
AUTHOR:	Tsipouras, P.		
INITIATOR:	Jasperse, J. (LQR)		
PROJECT:	5621	PROBLEM NO.	1336
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV		
MINIMUM CORE SIZE:	47_8k		

The purpose of this problem is to provide the solution of an integral equation for a three-body square-well scattering problem in Quantum Mechanics.

The inhomogeneous integral equation is solved by use of the Simpson's Rule.

For a description of the theory applied to solve the equation, refer to Problem Number 1045, Project Number 5621.

TITLE:	Impedance of a Piezoelectric Bar	
AUTHOR:	Poonen, K.	
INITIATOR:	Thomson, K. (LWW)	
PROJECT:	7639	PROBLEM NO. 1337
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	27_8k	

Five programs are concerned with the computation of the impedance of a bar and the resonances of a piezoelectric bar.

The impedance of a bar is calculated and printed as a function of the frequency as it varies in a given way.

The resonant frequencies (FR) of a piezoelectric bar are computed, and the smallest angle which will satisfy certain conditions is found.

Then the absolute value of the impedance and the angle "PHI" as functions of "F" (frequency) are found. Graphs of each of these results are also printed.

The ratio "FR/FA" is computed from a given relation, in a certain range of K (the constant of the equation).

Finally, the absolute value of the impedance vs "F/FR" and the angle "PHI" vs "F/FR" is calculated, printed and plotted.

TITLE:	Ray Tracing in the Ionosphere	
AUTHOR:	Kellaher, J.	
INITIATOR:	Wong, M. (LII)	
PROJECT:	4603	PROBLEM NO. 1338
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV, MAP	
MINIMUM CORE SIZE:	77_8k	

Two Hamiltonian ray tracing programs were developed by the Raytheon Company under Contract AF19(628)-5032 to simulate electromagnetic energy ray paths in the ionosphere. Both integrate numerically the Haselgrove differential equations to obtain the spherical coordinates of points along the ray path as functions of the phase path length.

The larger program, called "HRT-1," includes the affect of the refractive index. It also uses the electron collision frequency for computing the complex polarization. The electron density model is three-dimensional and global, and involves a Chapman profile. Several auxiliary quantities, group path length, ray path length, absorption, validity criterion, etc., are computed and tabulated at specific intervals of the phase path length. A pen-and-ink plot of the ray path may also be obtained.

The smaller program, "HRT-2," excludes the affects of the magnetic field and electron collisions. It computes and prints the ray position coordinates, phase path length and group path length. A two-dimensional density subroutine is used, in which linear interpolation is applied to density data specified along a meridian.

TITLE:	Solution of a Linear System of Equations
AUTHOR:	Russell, J.
INITIATOR:	Stevens, D. (LYB)
PROJECT:	7655 PROBLEM NO. 1339
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	7_8k

Several systems of linear equations were solved numerically. The general format is given by the following:

$$\Delta_1 = AT_1^3 + BT_1^2 + CT_1 + D$$

$$\Delta_2 = AT_2^3 + BT_2^2 + CT_2 + D$$

$$\Delta_3 = AT_3^3 + BT_3^2 + CT_3 + D$$

$$\Delta_4 = AT_4^3 + BT_4^2 + CT_4 + D$$

The coefficients solved were A, B, C and D. Seven sets of data were given for the values of Δ_1, Δ_2, Δ_3, Δ_4, T_1, T_2, T_3 and T_4.

TITLE:	Mutual Distance and Azimuth of Two Points on an Ellipsoid
AUTHOR:	Pustaver, J.
INITIATOR:	Wirtanen, T. (LWG)
PROJECT:	7600 PROBLEM NO. 1340
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	14_8k

The forward azimuth, reverse azimuth and mutual distance of two given points on the earth's ellipsoid are calculated. The two given points may be at different altitudes; therefore, distance is corrected to compensate for this.

Given a time of travel between the two points, the speed (in knots) required to travel the distance was computed.

Robbin's formula was used to compute the forward azimuth and distance and Cunningham's formula was used for the computation of reverse azimuth (see Bomford's Geodesy, pp 108-109, Oxford University Press, 1962).

TITLE:	Stress Wave Propagation in a Pre-stressed Medium
AUTHOR:	Russell, J.
INITIATOR:	Thomson, K. (LWW)
PROJECT:	7639 PROBLEM NO. 1341
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	24_8k

Stress components around a hole produced by stress waves in a prestressed medium were exhibited by several programs.

Some of the various calculations performed in this effort were: stress field around a hole, pure shear field around a hole, pure tension field around a hole, stress trajectories and maximum shearing stress from stress components in cylindrical coordinates, stress components generated by a "P-Wave," and stress components generated by an "S-Wave."

The programs generate listings of these components for various radial distances from a source and for various periods of time.

Stress components whose values depend upon a dipole force introduced into the medium are also calculated.

TITLE:	Energy Distribution of Photoelectrons
AUTHOR:	Birtwell, R.
INITIATOR:	McMahon, W. (LKO)
PROJECT:	6688 PROBLEM NO. 1342
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	2_8k

The purpose of this task was to plot experimentally determined energy distributions of photoelectrons ejected from a metal target by an impinging beam of extreme ultraviolet radiation (XUV) and to obtain the area under the amplitude curves at various combinations of wavelengths, angles of incidence and angles of photoelectron emission.

Data was recorded on strip charts, a baseline representing the level of background radiation pencilled in, and then the strip charts were digitized.

TITLE:	Rocket A07.902-4 Aspect Calculation		
AUTHOR:	Fioretti, P.		
INITIATOR:	Narcisi, R. (LKD)		
PROJECT:	6687	PROBLEM NO.	1343
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV		
MINIMUM CORE SIZE:	40_8k		

"RASP" is part of an operating system to calculate rocket aspect from gyroscopic data transmitted during flight. The corrected pitch and gyroscopic data from rocket number A07.902-4 is input to "RASP," which calculates the azimuth, elevation, and angle of attack of the rocket aspect. Altitude and magnetic field data are calculated as a function of time and output with the angle of attack between the longitudinal axis of the rocket and the velocity and magnetic field vector.

TITLE:	Analog-to-Digital Tape Conversion		
AUTHOR:	Jacobs, L.		
INITIATOR:	Hardy, K. (LYW)		
PROJECT:	6672	PROBLEM NO.	1344
HARDWARE/SOFTWARE:	IBM 1460/SPS		
MINIMUM CORE SIZE:	10_8k		

Magnetic tapes created on an analog computer are read in the SPS language by an IBM 1460 computer and are converted to digital DCS-compatible tapes.

The magnetic tapes are copied, and the records which cannot be read are deleted. Tape records from 1 to 1,000 words can be processed.

Along with the tape output, a message, describing file number completed, reel number, and number of records processed, is printed.

TITLE:	Spectral Analysis		
AUTHOR:	Grossbard, N.		
INITIATOR:	Chatterjee, S. (PHF)		
PROJECT:	8659	PROBLEM NO.	1345
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV		
MINIMUM CORE SIZE:	55_8k		

A general spectral analysis program developed at MIT was converted to the AFCRL DCS for general use. Control cards determine the type of analysis performed.

Some input options available to the user are:

a. Specification of the number of species whose spectra are to be superimposed.

b. Line shape of the observed spectrum.

   (1) Gaussian first derivative
   (2) Lorentzian first derivative
   (3) Stick
   (4) Gaussian second derivative
   (5) Gaussian absorption
   (6) Lorentzian second derivative
   (7) Lorentzian absorption

c. Point-by-point listing of the spectrum in intervals of .005 Gauss.

d. Normalization of the calculated spectrum to the dimensions of the observed spectrum.

e. Listing of the line positions and intensities.

f. A normal absorption spectrum or an inverted spectrum.

g. Line graphs or calcomp plots.

TITLE:	Conversion of CDC Tapes to DCS Format		
AUTHOR:	Jacobs, L.		
INITIATOR:	Kreitzberg, C. (LYS)		
PROJECT:	6698	PROBLEM NO.	1346
HARDWARE/SOFTWARE:	IBM 1460/SPS		
MINIMUM CORE SIZE:	10_8k		

Magnetic tapes to be processed by the IBM 7094 II-7044 DCS must contain records of complete 36-bit words. Occasionally tapes that are received from an outside source contain incomplete words. This program was written in a general form for the IBM 1460 to delete all records not containing multiples of 36 bits and to create a new tape that can be processed by the DCS.

The program can process multiple files and multiple reels during one run.

TITLE:	Solar Events Sift		
AUTHOR:	Armstrong, D.		
INITIATOR:	Barron, W. (LIR)		
PROJECT:	4629	PROBLEM NO.	1347
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV		
MINIMUM CORE SIZE:	40_8k		

Data concerning Solar Radio Distinctive Events were processed for further analysis. The purpose was to sort Solar Events by frequency, type and by whether or not the event had a post-burst increase (PBI) associated with it. Means and standard deviations are provided separately for each type at each frequency for (1) events with no PBI, (2) events with a PBI and (3) for the PBI's corresponding to the given event type. The means and standard deviations are for the duration of the events and for their peak flux. Also, events for which the start time, type, duration, or peak flux is uncertain are separated from the others and listed and are not used in finding means and standard deviations.

TITLE:	Jet Propulsion Laboratory Ephemeris Processing System		
AUTHOR:	Richardson, D.		
INITIATOR:	Hussey, I. (SUYA)		
PROJECT:	0001	PROBLEM NO.	1348
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV		
MINIMUM CORE SIZE:	33_8k		

The Jet Propulsion Laboratory Ephemeris Processing System uses solar, lunar, and planetary data from tapes supplied by the Jet Propulsion Laboratory to provide positions and velocities of designated bodies in the solar system.

There are two parts to the system. System I provides (1) view periods and look angles of the tabulated planetary body for a given tracking station, (2) view periods and look angles from specified trajectory positions at "n" kilometers above the earth's surface, (3) a magnetic tape of travel time ephemeris for a lunar laser ranging experiment and (4) physical ephemerides of the sun.

System II provides angular position and parallax data of the sun, moon and planets, Greenwich Sidereal Time and the heliographic coordinates of the center of the sun's disk, specifically adapted for Prospect Hill Radio Observatory.

TITLE: Rocket A0.902-3 Aspect Calculation
AUTHOR: Fioretti, P.

INITIATOR: Narcisi, R. (LKD)
PROJECT: 6687 PROBLEM NO. 1349

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 40_8k

"RASP" is part of an operating system to calculate rocket aspect from gyroscopic data transmitted during flight. The corrected pitch and gyroscopic data from rocket number A0.902-3 is input to "RASP," which calculates the azimuth, elevation, and angle of attack of the rocket aspect. Altitude and magnetic field data are calculated as a function of time and output with the angle of attack between the longitudinal axis of the rocket and the velocity and magnetic field vector.

TITLE: Spectroscopic Studies
AUTHOR: Doherty, R.

INITIATOR: Mapleton, R. (LKS)
PROJECT: 8627 PROBLEM NO. 1350

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 13_8k

The numerical solution of a number of multiple integrals aided a scientific investigation in spectroscopic studies.

Cross-sectional absorption function values as approximated by multiple sums over a range of Gauss-Legendre points and weighted appropriately with Gauss-Legendre weights are calculated.

The output consists of quantum mechanical cross-sectional absorption values as a function of energy.

TITLE: Pressure Level Data Reduction
AUTHOR: Armstrong, D.

INITIATOR: Salmela, H. (LKI)
PROJECT: 8624 PROBLEM NO. 1351

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 15_8k

In support of a climatological study, programs were written to calculate the averages and standard deviations of height and temperature at 15 pressure levels for four stations on a seasonal basis, over the period January 1955 to October 1959. Also calculated is the Root Mean Square (RMS) of differences for height and temperature at 15 pressure levels for two pairs of stations on a seasonal basis, over the same period of time.

TITLE: OV3-1 Plot Routines - Geiger Tube Experiment
AUTHOR: Dalton, L.

INITIATOR: Puskin, J. (PHE)
PROJECT: 8600 PROBLEM NO. 1352

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 21_8k

The purpose of this project was to make a survey of the Van Allen Belts by using the geiger tube data on the OV3-1 satellite. Calcomp plots of geiger tube voltages as a function of (systems) time from the merged data tapes were produced.

The following operations are performed by the program:

a. Any size plot can be generated.

b. The points per inch for the X and Y axis can be varied.

c. Any sequence of pins can be varied.

d. Variable titles for the plots can be generated.

e. Noisy data can be filtered.

TITLE:	Rocket AG7.882 Aspect Calculation
AUTHOR:	Fioretti, P.
INITIATOR:	Narcisi, R. (LKD)
PROJECT:	6687 PROBLEM NO. 1353
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	40_8k

"RASP" is part of an operating system to calculate rocket aspect from gyroscopic data transmitted during flight. The corrected pitch and gyroscopic data from rocket number AG7.882 is input to "RASP," which calculates the azimuth, elevation, and angle of attack of the rocket aspect. Altitude and magnetic field data are calculated as a function of time and output with the angle of attack between the longitudinal axis of the rocket and the velocity and magnetic field vector.

TITLE:	U-2 Plot – Thunderstorm Environmental Research
AUTHOR:	Spuria, A.
INITIATOR:	Glass, M. (LYC)
PROJECT:	8620 PROBLEM NO. 1354
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	52_8k

Data recorded on three aircraft flying missions through many storms was analyzed to assist the Cloud Physics Branch in a thunderstorm environmental research.

The program allows the user to select particular data to be plotted as a function of distance flown as well as aircraft flight tracks in ONC chart scale (1:1,000,000) for selected segments of the flight.

Erroneous map coordinates are detected by the program and are not plotted. The program offers the options of overlaying the plots for several parameters and of switching the North-South axis to lie vertical on the plot.

TITLE:	General Perturbations - Orbital Analysis		
AUTHOR:	Davis, S.		
INITIATOR:	Hussey, I. (SUYA)		
PROJECT:	0001	PROBLEM NO.	1355
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV		
MINIMUM CORE SIZE:	30_8k		

The General Perturbations Ephemeris Program (GPE) analytically predicts the orbital elements of close-earth satellites.

The first five input cards of the SPADATS element set are read and computations performed to obtain the corresponding elements at a specified time. The program generates new element cards, as well as a listing of the cards. It processes any number of element sets for orbits of all inclinations and eccentricities from 0 to .95.

Depending upon the ephemeris type specified by the input cards, the program will use one of three general perturbations models to integrate analytically the equations of motion. These models provide a complete first-order theory of the second, third and fourth zonal harmonics, a simplified version of this theory for equatorial orbits. A complete description of these models is given in Technical Documentary Report ESD-TDR-64-522.

TITLE:	Rocket AH7.893 Aspect Calculation		
AUTHOR:	Fioretti, P.		
INITIATOR:	Narcisi, R. (LKD)		
PROJECT:	6687	PROBLEM NO.	1356
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV		
MINIMUM CORE SIZE:	40_8k		

"RASP" is part of an operating system to calculate rocket aspect from gyroscopic data transmitted during flight. The corrected pitch and gyroscopic data from rocket number AH7.893 is input to "RASP," which calculates the azimuth, elevation, and angle of attack of the rocket aspect. Altitude and magnetic field data are calculated as a function of time and output with the angle of attack between the longitudinal axis of the rocket and the velocity and magnetic field vector.

TITLE:	Fourier Analysis of Interferometer Spectrometer Data		
AUTHOR:	Dolan, J.		
INITIATOR:	Cahill, J. (OPR)		
PROJECT:	5710	PROBLEM NO.	1357
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV		
MINIMUM CORE SIZE:	46_8k		

Infrared radiation data recorded aboard the AFCRL Optical KC 135 aircraft was analyzed. The objective of the program was to perform the necessary Fourier transformation, apodizations and convolutions in order to analyze the inter-program (raw data) into an optical spectrum.

Wavelength, interferogram, phase and integral are calculated and plotted. The program allows for either print plotting or Calcomp plotting or both.

TITLE:	Electromagnetic Back-scattering of Crossed Wires		
AUTHOR:	Korff, H.		
INITIATOR:	Holt, F. (LZE)		
PROJECT:	5635	PROBLEM NO.	1358
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV		
MINIMUM CORE SIZE:	15_8k		

The real and complex components of the electromagnetic back-scattering from a pair of thin conducting straight wires in the configuration of an equal-arm right-angle cross are calculated.

The ratio of the magnitudes of the back-scattered electromagnetic radiation from the two wires, and the phase of the orientable wire back-scattered radiation minus twice the phase of the fixed wire back-scattered radiations are computed. These values are calculated for 0, 10, and 90-degree orientation of the incident radiation.

TITLE: Photographic Calibration Studies
AUTHOR: Boudreau, R.

INITIATOR: Fitzgerald, J. (LQO)
PROJECT: 5620 PROBLEM NO. 1359

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 40_8k

Two programs aid in the task of determining the temperatures of titanium lines.

The first program assists in the analysis of photograph data recording of titanium line shifts in relation to star temperatures. The program generates the least-square fit to the plot of log (exposure) vs log (intensity), and the least-square fit to the same curve modified by the weighting function. The slopes and intercepts of both fitted least-square lines are punched on cards for use in the second program, which compares the weighted and non-weighted calculations of titanium line intensities. The temperature of the emitting titanium body is calculated.

TITLE: Solution of Triple Integrals
AUTHOR: Pustaver, J.

INITIATOR: Jasperse, J. (LQR)
PROJECT: 5621 PROBLEM NO. 1360

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 13_8k

Three triple integrals are evaluated using a modified Monte-Carlo method designed to compute multiple integrals.

The method used for the integration requires that the space be subdivided into a number of subcubes and points be randomly chosen within these subcubes for the evaluation of the function (see Haber, "A Modified Monte-Carlo Quadrature II, Mathematics of Computation," Vol. 21, No. 99, July 1967, pp 388-397).

TITLE:	Wind Data Reduction		
AUTHOR:	Navisky, D.		
INITIATOR:	Grantham, D. (LKI)		
PROJECT:	8624	PROBLEM NO.	1361
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV		
MINIMUM CORE SIZE:	10_8k		

Wind data recorded at Cape Kennedy and Santa Monica was analyzed as part of a climatological study. The program derives means and standard deviations of zonal and meridian wind components from wind data.

The means and standard deviations are categorized into the following sections: (a) annual, (b) monthly, (c) seasonal (winter, spring, summer, fall).

These components are further categorized into various altitude readings (3, 6, 9, 12, 15 km), which are again sectioned into various periods of readings (i.e., 4 times per day, 2 times per day, daily, every second day, every third day, every fourth day).

TITLE:	Low-Frequency Sounder Data Processing		
AUTHOR:	Dieter, K.		
INITIATOR:	Sales, G. (LII)		
PROJECT:	5631	PROBLEM NO.	1362
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV		
MINIMUM CORE SIZE:	75_8k		

In order to obtain a better understanding of the D-region of the ionosphere, a low-frequency sounder was constructed and installed at Quabban Reservoir in Massachusetts. The echoes resulting from a beam bouncing off the ionosphere were recorded on tape, and the data on the tape is converted for use on the CDC 6600.

The "digicoder," which prints on a strip of paper the various characters with an intensity that is directly proportional to their magnitude, is simulated by producing on the CRT a plot which very closely resembles the plot produced by the digicoder.

The output consists of a printout of the reformatted data, plus a CRT plot of the D-region profile.

TITLE: Solar Event Study
AUTHOR: Spuria, A.

INITIATOR: Barron, W.
PROJECT: 5629 PROBLEM NO. 1363

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 42_8k

Data recorded during the observation of solar radio emissions at five different frequencies was processed by a series of programs.

The programs perform basically the same function for three different types of data -- distinctive event flux values, daily flux values and minute-by-minute flux values.

Least-square polynomial fits were made of the logs of the frequencies of flux values. For each group of data points, the polynomial coefficients and a measure of goodness of fit, as well as a comparison of flux values to their appropriate polynomial values, are provided. The results may be plotted by the Calcomp if desired.

TITLE: Gravimeter Data Print
AUTHOR: McMurray, J.

INITIATOR: Perry, R. (LWG)
PROJECT: 7600 PROBLEM NO. 1364

HARDWARE/SOFTWARE: IBM 1460/SPS
MINIMUM CORE SIZE: 3_8k

An 8-channel punched paper tape containing earth tide gravimeter data is read and printed. The data consists of a run number in the form of a Julian date, time in hours and minutes, and gravity parameters, which are decoded into numerical data and printed.

The data is to be stored on magnetic tape and sent to Columbia University for the eventual incorporation into a world-wide study on earth tides.

TITLE: Lunar Librations
AUTHOR: Dieter, K.

INITIATOR: Eckhardt, D. (LWG)
PROJECT: 8607 PROBLEM NO. 1365

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV, MAP
MINIMUM CORE SIZE: 30_8k

When solving the Euler Dynamical Equations for the rotation of the moon, one encounters a term whose amplitude is three years, which is very close to the resonant period of free libration in longitude of the moon.

In order to study this term more closely, the author has introduced non-linearity and dissipation into the differential equation associated with this term, as well as secular changes in the moon's orbit about the earth. The program solves the differential equation and plots the results as a phase plane diagram.

The results of this study will have a bearing on determining the exact period of resonance of free libration of the moon, as well as on lunar laser observations and the question as to the exact composition of the moon's core.

TITLE: OV1-86 Ephemeris Data Merge
AUTHOR: Cook, R.

INITIATOR: McInerney, R. (SUYA)
PROJECT: 0001 PROBLEM NO. 1366

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 23_8k

Satellite OV1-86 data is merged with ephemeris data for further analysis of the experimental data. The satellite data tape is searched for time and voltage readings. The same time is selected from the ephemeris data in order to merge the two and produce a new tape for further processing.

If the times on the data and ephemeris tapes do not coincide, an error message is output.

TITLE: Ionospheric Periodicities Detection
AUTHOR: Spuria, A.

INITIATOR: Corbett, J. (LII)
PROJECT: 5631 PROBLEM NO. 1367

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 73_8k

Decibel values are plotted versus universal time, and the power spectrum for the data on specific days is calculated. There are options for tapering and smoothing the data. Logarithmic scales are used on both axes, and the scaling can be changed at will.

The purpose is to detect and verify periodicities in the ionospheric data by examining data from various stations during different time periods.

TITLE: Field Interactions
AUTHOR: Wright, W.

INITIATOR: Hollingsworth, L. (CA)
PROJECT: 000D PROBLEM NO. 1368

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 40_8k

A double precision program was written to evaluate particle positions using the two-body principle for known masses. Under given initial conditions, the orbital path and characteristics of some mass (F2) about a larger mass (F1) are computed. The central force equations coupled with an x, y component approach and iteractive scheme are used to evaluate the positions.

Force, radius, velocity, certain angles and distances are printed.

TITLE: Calculation of Effective Parameters for Hot Magnetoplasmas
AUTHOR: Atkinson, J.

INITIATOR: Papa, R. (LZP)
PROJECT: 4642 PROBLEM NO. 1369

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 30_8k

There are two important effects which occur in a hot magnetoplasma. One effect is transconductance, in which the conductivity at a given point in the plasma is not due entirely to the drift velocity of the electrons acquired by the presence of the electric field at that point, but may depend upon the effect of the electrical field at neighboring points.

Another effect which occurs in a hot plasma is collisionless damping, of which there are two types; Landan damping and cyclotron damping. Both types involve the transfer of energy between the electromagnetic wave and a group of resonant particles whose thermal velocity lies close to the wave phase velocity.

The effective parameters for the hot plasmas are functions of signal frequency, plasma frequency, cyclotron frequency, constant collision frequency and electron temperature.

The calculation of effective parameters for hot magnetoplasmas is performed in four steps, as follows:

a. Effective parameters

b. Effective parameters - collisionless damping

c. Effective parameters - all interactions

d. Asymptotic expansions for effective parameters

Curves of these parameters are plotted as a function of normalized plasma frequency for different values of normalized electron energy and normalized collision frequency.

TITLE: Trace Orbit Determination Program Conversion
AUTHOR: Stoll, D.

INITIATOR: Hussey, I. (SUYA)
PROJECT: 0001 PROBLEM NO. 1370

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV. MAP
MINIMUM CORE SIZE: 77_8k

The Trace Orbit Determination system was converted to the IBM 7044-7094 DCS. The original program was written at Aerospace Corporation in Fortran IV FMS, and the purpose of this task was to enable the Trace-D program to operate in Fortran II or FMS.

The Trace-D program has four major modes of operation, (1) ephemeris generation, (2) orbit determination, (3) data conversion and (4) residuals analysis.

This DCS version of the program has been replaced by "TRACE-66" for the CDC 6600.

Not available for distribution because of the complexities of operating this system. However, data can be generated upon request.

TITLE: Turbulent Shear Flow
AUTHOR: Mazzio, V.

INITIATOR: Wyngaard, J. (LYB)
PROJECT: 7655 PROBLEM NO. 1371

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 73_8k

For the study of turbulent shear flow, the eigenvalue μ satisfying two simultaneous integral equations is determined.

After Simpson's Rule has been applied to the integral expressions, an iterative scheme is used to the resulting n-algebraic equations.

Output consists of the computed results and c.. line plots.

TITLE:	Neutron Monitor Data Plot
AUTHOR:	Stoll, D.
INITIATOR:	Smart, D. (PHE)
PROJECT:	8600 PROBLEM NO. 1372
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	72_8k

In order to analyze neutron monitor data in conjunction with a cosmic radiation study, a plot program was designed to display pressure data on the bottom of the plot, uncorrected data in the middle and corrected data at the top for ease in comparison.

The program can handle hourly values up to one year of data.

TITLE:	Weather Prediction Technique - Radar Echoes
AUTHOR:	Kelley, R.
INITIATOR:	Conover, J. (LYS)
PROJECT:	6698 PROBLEM NO. 1373
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	32_8k

Two programs were written to expediently analyze data on radar weather observations from Southeast Asia in support of improved weather prediction techniques. Data is recorded at various radar stations, which make hourly weather observations on the local weather activity within a range of 200 miles. The observers record polar coordinate data representing the echoes for that hour. Other recorded data, such as density, trend, tendency, and height, provide a snapshot of the weather situation.

A set of hourly snapshots of the radar screen is plotted and an hourly Radar Index (RI) is calculated. The RI is the sum of the weighted echoes within a range of 50 miles of the station, divided by the area of the 50-mile circle.

TITLE: Scintillation Analysis
AUTHOR: Hoffman, R. and DeSantis, L.

INITIATOR: Aarons, J. (LIR)
PROJECT: 4643 PROBLEM NO. 1374

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 75_8k

Program "SCINTA" performs an analysis of an airborne object by virtue of its scintillation. The parameters used in the analysis are: latitude, longitude, time, number of observations, mean Faraday period, mean scintillation index, mean zenith angle, mean scintillation - Faraday index.

The analysis is performed using varied parameter matrices. For each set of readings, there are basically five types of matrices produced: latitude vs time vs (x) vs latitude vs longitude -- where (x) = one of the aforementioned parameters.

TITLE: Solar Flux Correlations
AUTHOR: Korff, H.

INITIATOR: Barron, W. (LIR)
PROJECT: 4643 PROBLEM NO. 1375

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 70_8k

Auto and cross correlations were performed on sixteen variates of solar flux data for any desired three-year period. The sixteen variates of data were recorded in the format of one data value per day. The data was stored by day number and correlated according to a code specified by the user.

The data was plotted with correlation versus lag.

TITLE: Ultraviolet Radiation Measurement Data Processing
AUTHOR: Spuria, A.

INITIATOR: Manson, J. (LKO)
PROJECT: 6688 PROBLEM NO. 1376

HARDWARE/SOFTWARE: IBM 7094 II 7044 DCS/Fortran IV
MINIMUM CORE SIZE: 23_8k

Researchers in the Solar Ultraviolet Branch at AFCRL have been investigating the effect of the sun's ultraviolet radiation on the upper atmosphere of the earth and have been studying this radiation as it penetrates the atmosphere. The system of XRAY programs was designed to process data measuring ultraviolet radiation in the range 30 Å - 130 Å. The data was collected via rocket flights. Data has generally been recorded using Fm-Fm analog telemetry and the present use of digitization represents a first effort at utilizing a computer for processing the data.

In the spectral region below 130 Å, lines of accurately known wavelengths are all quite weak and very densely spaced. Blending of the lines and general lack of previous data made the post-launch adjustment of wavelength scales difficult. This problem was somewhat simplified by averaging 3 scans of data, thus reducing the random statistical variation inherent in the data.

The package of programs written under this problem number contains routines to:

a. Unpack the digitized tape

b. Linearize the data scans (necessary because of equipment trouble)

c. Reverse scan C

d. Determine scale shifts between scans

e. Average scans B, C and D

f. Plot individual and/or average scans, averaging data if desired

g. Determine parameters for sinusoidal wavelength curve

h. Plot average scan with AFCRL and NRL line lists

i. Plot segments of different flights for comparison.

TITLE:	Computation of Space Intersection
AUTHOR:	Wright, B.
INITIATOR:	Hadgigeorge, G. (LWG)
PROJECT:	7600 PROBLEM NO. 1377
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	5_8k

Given the coordinates of two stations and angles for sighting from each station, the coordinates of sighted objects are computed. The program also converts station coordinates to earth-fixed system, calculates unit vectors (in the earth-fixed system) from each station toward the flash point, computes the residual parallax and the ranges to the flash point and several vectors needed to position the object.

TITLE:	Response of Spherical Cavity to Stress
AUTHOR:	Persakis, T.
INITIATOR:	Bliamptis, E. (LWW)
PROJECT:	7639 PROBLEM NO. 1378
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS; CDC 6600/Fortran IV
MINIMUM CORE SIZE:	60_8k

This program computes the response of a spherical cavity to an applied stress. Also, the radical displacement and other variables are computed and plotted as functions of time.

The radical displacement, generated by a unit step in pressure, decays exponentially. The pressure acts on the wall of the spherical cavity in an infinite medium. The far-field and near-field corrections are output separately.

Plot output consists of the calculated spherical cavity functions, with normalized amplitudes plotted versus normalized times.

Both the original DCS version and the CDC version of the program have been retained and are available for use.

TITLE:	Electron Density in the Ionosphere
AUTHOR:	Kellaher, J.
INITIATOR:	Mullen, J. (LIR)
PROJECT:	4643 PROBLEM NO. 1379
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	43_8k

The electron density in the ionosphere is tabulated as a function of height, colatitude and longitude, together with the partial derivatives of density with respect to height, colatitude and longitude.

The main program exhibits in tables the outputs of any of a class of electron density subroutines used in programs for ray tracing · the ionosphere.

The density subroutine included in this problem is based on a subroutine received from the Raytheon Company as a component of its ray tracing program "HRT-1" (see Problem Number 1338).

This density model has been augmented by two local maxima of electron density, representing additional ionospheric layers. The local maximum values of electron density, and the heights at which they occur, may be adjusted by specifying appropriate inputs to this subroutine.

TITLE:	OV3-6 Ion Mass Spectrometer Data Reduction
AUTHOR:	Desrochers, R.
INITIATOR:	Philbrick C. (LKD)
PROJECT:	6687 PROBLEM NO. 1380
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	33_8k

The main task involved in this project was mass spectra peak recognition. The overall problem included several operations on the raw data received from the OV3-6 satellite to make the data useful for scientific evaluation.

The OV3-6 IMS Program reduces the data from the 120-segment sweep commutator. The odd commutated pins represent data from the MS II experiment; the even pins, from the MS I experiment. Only one set of pins is processed at one time.

The program locates 32 mass peaks which are measured during one sweep. The masses of interest (of the 32 being measured) are 1, 4, 8, 14, 16, 18, 20, 28, 30 and 32. Total ions (a measurement which appears at the beginning of each sweep) has its value determined by taking an average of N values. The high and low calibration voltages are also of interest, appearing at the beginning of every third sweep. They are also measured by taking an average.

The mass peaks, total ions, calibrations and range times are listed and written on an output tape for further processing.

TITLE: Data Reduction of OV3-2 Retarding Potential Analyzer
AUTHOR: Fioretti, R.

INITIATOR: Sandock, J. (LIJ)
PROJECT: 7663 PROBLEM NO. 1381

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 57_8k

Data recorded on the OV3-2 satellite for the retarding potential analyzer experiment was reduced for further analysis. The telemetry voltage output of the two retarding potential analyzer detectors on board was converted to current, and log current and voltages on the aperture and retarding grids were computed.

TITLE: Ionospheric Variation Analysis
AUTHOR: Boudreau, R.

INITIATOR: Toman, K. (LII)
PROJECT: 5631 PROBLEM NO. 1382

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 42_8k

This program was written to assist in the analysis of the structure and characteristics of the ionosphere. Radio transmission data is read and processed for the purpose of providing 30-inch graphical display of on and off times of radio transmissions controlled by ionospheric variation.

Data from any year may be input. The program produces a Calcomp plot of transmission versus time over a year's period, and also indicates the times of sunrise and sunset for each day.

TITLE: Magnetometer Axis Direction
AUTHOR: Boudreau, R.

INITIATOR: Kuck, G. (PHE)
PROJECT: 8600 PROBLEM NO. 1383

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 27_8k

Magnetometer outputs from spin stabilized vehicles were processed for further analysis. The equation of motion, a modified cosine, was plotted as a function of time. The principal modifying variables within the function include the spin and precession of the vehicle.

TITLE: PCA Rocket Trajectory
AUTHOR: Ulwick, J. (LIJ)

PROJECT: 7633 PROBLEM NO. 1384

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 31_8k

"TRAJ-1" of Problem No. 1236 is used to generate rocket trajectories for Polar Cap Absorption (PCA) events which occurred at Fort Churchill, Canada, in November , 1969

The trajectories were generated for rocket numbers AJ17.602, AJ17.758, AJ17.616, A17.906-1 and AJ17.617.

TITLE: PCA Rocket Trajectory
AUTHOR: Robinson, E.

INITIATOR: Weeks, L. (LKB)
PROJECT: 5710 PROBLEM NO. 1385

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 31_8k

"TRAJ-1" of Problem No. 1236 is applied to rockets A30.900-2 and A30.900-3, for which rocket trajectories are generated. These rockets were flown into the Polar Cap Absorption (PCA) event of November, 1969, at Fort Churchill, Canada.

TITLE:	Seismic Parameters of Multi-Layered Earth Models
AUTHOR:	Armstrong, D.
INITIATOR:	Ossing, H. (LWH)
PROJECT:	7639 PROBLEM NO. 1386
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	75_8k

A CDC-1604 computer program written in Fortran 63 was converted to the DCS.

It computes seismic parameters of multi-layered earth models (for example, phase velocity, group velocity, homogeneous displacement, ratios, periods, media response, energy and phase velocity particles). The parameters are used in simulating the layered media effect on the propagation of seismic Rayleigh waves.

TITLE:	PCA Rocket Trajectory
AUTHOR:	Robinson, E.
INITIATOR:	Narcisi, R. (LKD)
PROJECT:	6687 PROBLEM NO. 1387
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	31_8k

"TRAJ-1" of Problem No. 1236 is applied to rockets [illegible] ?-3, AG7.882, AH7.886, A07.902-4, AH7.893, A07.902-2 and AH7.8[illegible]

Rocket trajectories are generated for the above mentioned rockets flown into the Polar Cap Absorption (PCA) event of November, 1969, at Fort Churchill, Canada.

TITLE: Secondary Emission Studies
AUTHOR: Birtwell, R.

INITIATOR: Frederickson, R. (LQR)
PROJECT: 56[illegible]0 PROBLEM NO. 1388

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 75_8k

This computer program handles the measurements of secondary electron emission affects on metals and dielectrics in a radiation environment. An automated digital recording system is used to collect many data points over long intervals of time.

The data is recorded on punched tape and converted to punched cards, and a statistical analysis and graph plotting of the data is accomplished by the program. The program plots several thousand data points, enabling the user to analyze non-stop data in a concise form.

TITLE: PCA Rocket Trajectories
AUTHOR: Robinson, E.

INITIATOR: Faire, A. (LKB)
PROJECT: 6690 PROBLEM NO. 1389

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 31_8k

"TRAJ-1" of Problem No. 1236 is applied to rockets AT7.395, AT7.396, AT7.397, AT7.398 and AT7.179.

Rocket trajectories are generated for the above-mentioned rockets flown into the Polar Cap Absorption (PCA) event of November, 1969, at Fort Churchill, Canada.

TITLE: OV1-13 Merge and Ephemeris Determination
AUTHOR: Hussey, I.

INITIATOR: Rothwell, P. (PHE)
PROJECT: 8600 PROBLEM NO. 1390

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 10_8k

"MEEP2" (MErge Ephemeris and PCM) partially unpacks OV1-13 PCM telemetry data and merges it with the corresponding ephemeris data onto a Fortran-formatted tape.

"MEEP2" locates a designated orbit and start time on each of two magnetic (PCM telemetry and ephemeris) tapes, and merges it. The data is written onto a third magnetic tape and selected data is output on the system printer.

Since PCM data occurs every second and ephemeris data every minute, intermediate ephemeris data is obtained by using Lagrangian interpolation.

TITLE: Cumuius Cloud Modelling
AUTHOR: Wright, B.

INITIATOR: Glass, M. (LYC)
PROJECT: 8620 PROBLEM NO. 1391

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 43_8k

The program reads soundings recorded on weather flights: cloud base, radius of the cloud, temperatures at which freezing occurs. It computes (from a system of differential equations) the water content, temperature, and vertical velocity of the cloud being formed from the base to its top. The program also computes amount and duration of rainfall.

The water content, temperature, temperature excess, and vertical velocity of the cloud are plotted as a function of height. A summary plot is also generated of cloud top vs cloud radius.

TITLE:	Atmospheric Transmission Computation
AUTHOR:	Persakis, T.
INITIATOR:	Volz, F. (OPA)
PROJECT:	7621 PROBLEM NO. 1392
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINUMUM CORE SIZE:	12_8k

Solar radiation intensity is measured daily at various tropical stations and at AFCRL, Hanscom Field, Bedford, Mass. The aerosol attenuation and water vapor content of the atmosphere are calculated at different wavelengths from these measurementsffor the purpose of determining the turbidity of the atmosphere.

Two programs perform this computation. Both versions input temperature coefficients, present solar distance, air attenuation coefficients, instrument temperature, date, time, optical path length and solar intensity measurements. However, one of the versions performs a linear correction to the intensity measurements. The output consists of the transmission coefficients at four different wavelengths plus the water vapor amount.

TITLE:	Analysis and Data Reduction of Wind Speed Components
AUTHOR:	Atkinson, J.
INITIATOR:	Cole, A. (LKI)
PROJECT:	8624 PROBLEM NO. 1393
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	4_8k

The mean, standard deviation and linear correlation coefficient between wind speed components observed simultaneously at several locations for approximately 66 sets of observations, each containing four altitude increments with 20 pairs of wind components were calculated and printed in a table.

TITLE:	Free-Body Scattefing	
AUTHOR:	Doherty, R.	
INITIATOR:	Jasperse, J. (LQR)	
PROJECT:	5621	PROBLEM NO. 1394
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	25_8k	

"INTEGRAL EQ" was written to aid in the numerical solution of a number of integral equations which deal with a "free-body scattering" problem.

The logical design of this program can be used as a framework for developing higher order systems of integral equation solutions.

This problem solves a non-homogeneous equation by Gauss-Laguerre integration approximation.

TITLE:	Scintillation Data Plots	
AUTHOR:	Spuria, A.	
INITIATOR:	Aarons, J. (LIR)	
PROJECT:	4643	PROBLEM NO. 1395
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	27_8k	

Scintillation data obtained from the "Canary Bird" Satellite and gathered by various stations throughout the world was plotted. Index and rate, or rate only, are plotted; the plot is labelled with the date on which the data was obtained and the recording station.

The program allows for superimposing one plot upon another.

TITLE: Analysis of Ionospheric Irregularities
AUTHOR: Grossbard, N.

INITIATOR: Elkins, T. (LIR)
PROJECT: 4643 PROBLEM NO. 1396

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS; CDC 6600/Fortran IV
MINIMUM CORE SIZE: 73_8k

Seven DCS programs were written to perform functions such as power spectrum analysis and cross-correlation for the study of ionospheric irregularities by the use of satellite beacon transmission. The analysis of such properties as the power spectrum and bispectrum of the time series of a beacon signal enables the determination of fluctuations that the ionospheric irregularities introduce into these transmissions. The structure of the ionosphere can be determined from the analysis of these irregularities.

Of these seven programs, one program, which develops a Fourier analysis of the input ionospheric data and makes statistical tests to determine if any periodicities exist in the data, has been converted to the CDC.

TITLE: Atomic Oxygen Density Variations
AUTHOR: Wright, B.

INITIATOR: Sales, G. (LII)
PROJECT: 5631 PROBLEM NO. 1397

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 15_8k

A differential equation describing atomic oxygen density as a function of time is solved.

The program consists of a main program which sets up initial conditions, the step size, final value limits and the accuracy desired; a subroutine, which is a general purpose routine to solve differential equations using Ralston's method; and a subroutine which computes $\frac{dn}{dt}$.

All computations are done in double precision. The program, which can compute the initial condition so that the equations are in equilibrium at the starting time, is applicable to many equations arising from the study of photochemical production and dissociation of molecules in the atmosphere.

TITLE:	Optical Constants from Reflectance Measurements
AUTHOR:	Wright, B.
INITIATOR:	Loewenstein, E. (OPI)
PROJECT:	7670 PROBLEM NO. 1398
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	20_8k

Optical constants are derived from up to 600 reflectance measurements.

The reflection spectrum, containing all the terms of reflectance equation, is read in. Two parameters within the reflectance equation are found, transmittance and the Fresnal coefficient at normal incidence.

TITLE:	Computation of Adjusted Coordinates of an Artificial Satellite
AUTHOR:	Harris, S.
INITIATOR:	Hadgigeorge, G. (LWG)
PROJECT:	7600 PROBLEM NO. 1399
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	14_8k

Given certain formulae, the program computes the topocentric equatorial cooridnates of an artificial earth satellite on the basis of synchronous observations made at the geocentric rectangular coordinates of two known points on the earth surface.

The equations used in the program were taken from a publication by the Polish Academy of Sciences on Artificial Satellites, Warsaw, Poland, Vol. 2, No. 1, March 1966.

TITLE: Microstrip Cavity Analysis
AUTHOR: Lonergan, F.

INITIATOR: Karas, N. (LZP)
PROJECT: 4642 PROBLEM NO. 1400

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 16_8k

The microstrip cavity (a non-radiating, open transmission device) has fringing fields which can be modified by an external medium. The modifications of the internal parameters characterizing the cavity (including the capacitance) can be related back to the outside medium which caused the perturbation.

This problem determines the geometrical dependence on the numerical results of the equivalent transmission line capacitance of the microstrip cavity.

TITLE: Shock Wave in a Plasma
AUTHOR: Wright, B.

INITIATOR: Prasad, B. (PHD)
PROJECT: 8647 PROBLEM NO. 1401

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 5_8k

A system of three non-linear, first-order, ordinary differential equations describing a shock wave in a plasma is solved. The equations are solved by a low-order stable predictor corrector method with modifier, which automatically varies the step size.

TITLE:	Elastodynamic Radiation from a Propagating Tensile Fault
AUTHOR:	Doherty, R.
INITIATOR:	Thomson, K. (LWW)
PROJECT:	7639 — PROBLEM NO. 1402
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	61_8k

Seismologists are assisted in solving numerically a number of equations which describe a model of strain values associated with a near-field fault rupture.

"EDR" generates strain waveforms as a function of time. The original time function values were stored on magnetic tape by Problem No. 1316, and are used as input to "EDR". The values are combined to approximate spatial partial derivatives, which are then combined to represent tensor quantities. These quantities are displayed both graphically through CRT plots and in tabular form on data listings.

TITLE:	Analysis of Aspect System Magnetometer Data
AUTHOR:	Parsons, C.
INITIATOR:	Ulwick, J. (LIJ)
PROJECT:	7663 — PROBLEM NO. 1403
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	60_8k

Program "RFIT" performs a least-squares fit to support the analysis of aspect system magnetometer data flown on various Air Force rockets. The roll rate of a rocket is determined as a function of time by means of a least-squares fit representation of the spin magnetometer data. The magnetometer data is modulated at two frequencies, one of which may be unknown. The program will determine the unknown frequency, that is, roll rate, which best fits the data. The constants determined make it possible to generate the original data as a function of time alone. The constants are determined according to Cramer's Rule.

TITLE: Hourly Wind Correlations
AUTHOR: Atkinson, J.

INITIATOR: Tattelman, P. (LC)
PROJECT: 8624 PROBLEM NO. 1404

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 71_8k

Hourly wind correlations are determined at representative stations at several levels of altitude for possible use with a prognostic model of the wind. To find these correlations, the cumulative frequencies of the magnitude of the wind vector are calculated for four seasons individually at each station.

A listing of wind speeds from 1 to 100 and the number of times they occurred by month and by season are output. The cumulative frequency of each speed is also printed.

The data was recorded twice daily at Cape Kennedy and four times daily at Santa Monica.

TITLE: Analysis of Modulated Signals
AUTHOR: Grossbard, N.

INITIATOR: Lammers, U. (LZN)
PROJECT: 8683 PROBLEM NO. 1405

HARDWARE/SOFTWARE: CDC 600/Fortran IV
MINIMUM CORE SIZE: 47_8k

The feasibility of angle-of-arrival detection in a one-dimensional antenna array consisting of "n" antennas is studied, where the antennas are equi-distant and the received signals are added linearly at the position of the nth antenna. The received signal is a sawtooth function with a periodic decrease in frequency.

The sum signal arriving at the nth antenna is made up of a series of periodic frequency sweeps, with relative time delays typical of the angular position and distance of the signal source. A spectral analysis of the sum signal is performed for selected positions of single and multiple targets. Unity-received power is assumed for all targets.

A program was written to simulate mathematically radar effects of moving targets. The resultant data is passed through a Fast Fourier Transform and analyzed in terms of amplitude and phase versus frequency.

TITLE:	OV1-15 MSII Correction	
AUTHOR:	Jacobs, L.	
INITIATOR:	Philbrick, C. (LKD)	
PROJECT:	6687	PROBLEM NO. 1406
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV	
MINIMUM CORE SIZE:	41_8k	

The experimental measurements from the Ion Mass Spectrometer on the OV1-15 satellite are corrected by an emission regulator correction factor.

Included in the output are GMT, altitude, emission regulator voltages, and attack angles in one section; and GMT, current, attack angle, EMR voltage, correction factor and corrected currents in the next section. The $\log_{10}$ of each current is also listed.

TITLE:	Solar Optical Investigations	
AUTHOR:	Delaney, J.	
INITIATOR:	Gronin, E. (SUYA)	
PROJECT:	000D	PROBLEM NO. 1407
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS; UNIVAC, 1108 EXEC 8/ Fortran IV; Fortran V	
MINIMUM CORE SIZE:	50_8k	

Several programs were written as part of the Solar Space Forecasting System for the Air Weather Service's Global Weather Control Data Reduction System for meteorological information.

The programs are capable of creating, sorting, updating and publishing plage, flare, sunspot and patrol reports received from several solar geophysical observatories.

A data association program uses the plage, sunspot and flare program packages to create solar regions in accordance with the criteria established by the AFCRL Space Physics Laboratory.

The Quasi Mercator Solar Map program prepares solar maps at 00Z and 12Z hours for preceding 12 hours for all plages, sunspot groups, flares and subflares which occur between 90°E and 90°W of the central meridian.

Plot programs were also written to aid in assessing activity trends and in assisting SFC forecasters in preparing the solar flare forecast.

TITLE:	Solar Space Forecasting - Radio Interference
AUTHOR:	Delaney, J.
INITIATOR:	Cronin, E. (SUYA)
PROJECT:	000D PROBLEM NO. 1408
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS; UNIVAC 1108; EXEC 8/ Fortran IV, Fortran V
MINIMUM CORE SIZE:	65_8k

Four programs were written as part of the Solar Space Forecasting System for the Air Weather Service in conjunction with the Solar Forecast Center at Ent Air Force Base in Colorado Springs, Colorado.

The first program groups and associates reports of radio interference with reports of solar flares to determine a cause-and-effect relationship between the two phenomena.

The Solar Rad Emission Spectral Observation program sets up and maintains a 21-day active file of spectral frequency observation reports.

Next, a summary of real-time integrated solar radio flux data is produced for five stations. The reports which include observation and frequency information are added into a 90-day file on a master tape.

The Radio Operational Reporting program reports on the status of each radio observatory's observational equipment at the start (sunrise) and end (sunset) of the local observing day. Daily coverage and noncoverage summaries for each station/frequency are listed. Also output is a monthly noncoverage time summary for each frequency in the network and a monthly instrument downtime summary.

TITLE:	Solar Space Forecasting - Sun Map Rotation
AUTHOR:	McMurray, J.
INITIATOR:	Cronin, E. (SUYA)
PROJECT:	000D PROBLEM NO. 1409
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS; UNIVAC 1108; EXEC 8/ Fortran IV, Fortran V
MINIMUM CORE SIZE:	70_8k

The Sun Map Rotation program assists in the processing of radio sun map data as part of the overall effort for the Space Forecasting Center.

Three different types of radio sun map temperature data from three observation sites are accepted in matrix form. A history file and active 3-day file containing both input and output data are updated continuously as reports of solar activity are transmitted.

Included is a paper tape punch program which provides a means of transmitting radio sun map data generated at Prospect Hill Radio Observatory over teletype communication lines.

TITLE:	Solar Space Forecasting - Magnetometer Data Processing
AUTHOR:	Shea, E.
INITIATOR:	Cronin, E. (SUYA)
PROJECT:	000D PROBLEM NO. 1410
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS; UNIVAC 1108, EXEC 8/ Fortran IV; Fortran V
MINIMUM CORE SIZE:	50_8k

Two programs were designed as part of the Solar Space Forecasting System for the Air Weather Service and the Solar Forecast Center at Ent Air Force Base in Colorado Springs. This system will be part of the Air Weather Service's Global Weather Central data reduction system for meteorological information.

"MAGNET" receives regular and irregular real-time reports from 20 magnetometer sites, stores all (good) received data and associated indices in a 21-day file, computes and stores 24-hour average daily planetary geomagnetic index A_p in a 30-day file, and tests for indications of a geomagnetic storm.

The program can output either a 24-hour geomagnetic data summary, a time association with other solar data when a storm is indicated, or a statement signifying a storm is still in progress, or a special observation report.

"MAGAVE," using information contained in the 24-hour file generated by "MAGNET," averages the magnetometer deflections reported by the geomagnetic storm-predicting stations Thule, Goose Bay, Eielson, Loring, Fort Belvoir and Manila. Specifications for the particular stations to be averaged and the time interval over which the averages are to be computed are part of the program request, and remain in effect until new specifications are received. Output consists of a table giving the average deflection for each 90-minute or 3-hour report and a list of the participating stations.

TITLE: Energetic Particle Investigations
AUTHOR: Cunningham, J.

INITIATOR: Cronin, E. (SUYA)
PROJECT: 000D PROBLEM NO. 1411

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS; UNIVAC 1108 EXEC 8/ Fortran IV; Fortran V
MINIMUM CORE SIZE: 17_8k

Neutron Monitor data is processed and analyzed as it is received by the Air Weather Service via the SOFNET teletype circuit.

Neutron Monitor data will be transmitted from five different monitors. The program performs the following:

a. Checks the incoming data with respect to format.

b. Maintains a short-time history of the data as it is processed.

c. Determines unusual deviations in the cosmic-ray intensity.

d. Notifies the Solar Forecast Center of possible Forbush decreases.

e. Notifies the Solar Forecast Center of a possible solar cosmic-ray event.

f. Provides necessary plots to the Solar Forecast Center.

g. Stores pertinent data for transmission to the update program for proton-intensity time prediction.

TITLE: Satellite Data Plots
AUTHOR: Boudreau, R.

INITIATOR: Champion, K. (LKB)
PROJECT: 6690 PROBLEM NO. 1412

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 30_8k

Punched card input containing measured and predicted satellite position vectors is read and the vector differences are computed.

Calcomp plots technically suitable for reproduction in scientific reports are generated for up to 1000 data sets.

TITLE: Ionospheric Forecasting Model
AUTHOR: Vorenberg, P.

INITIATOR: Cronin, E. (SUYA)
PROJECT: 000D PROBLEM NO. 1413

HARDWARE/SOFTWARE: Not Applicable
MINIMUM CORE SIZE: Not Applicable

The analysis work was performed as part of a research and development effort for the Space Forecasting Development and Data Processing project in conjunction with the Air Weather Service SolarForecast Center at Offutt Air Force Base, Omaha, Nebraska.

The main task involved the development of a mathematical model required to process f-min, riometer and solar x-ray data parameters. These parameters were utilized to predict absorption values for Polar Cap Absorption (PCA) events and Lowest Usable Frequencies (LUF) over middle latitudes.

TITLE: Upper Atmospheric Density
AUTHOR: Erickson, P.

INITIATOR: Cronin, E. (SUYA)
PROJECT: 000D PROBLEM NO. 1414

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 10_8k

"DENFOR" predicts density for a "normal case," which includes the auroral region (ZULU = 1300, Latitude = 70°, Longitude = 76°) and the sub-solar point (longitude = 90°). Also there is the capability of forecasting density for a "special case" in which the longitude and latitude must be input. In addition, "DENFOR" allows for forecasting up to three days in advance.

TITLE:	Sounding Analysis	
AUTHOR:	Chin, J.	
INITIATOR:	Kantor, A. (LKI)	
PROJECT:	8624	PROBLEM NO. 1415
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	12_8k	

Programs "ML-UNPAK" and "SLEDIT" were written to edit the mandatory and significant level data tapes for a sounding analysis program ("MIDWEST"). The original BCD tapes are in a format unacceptable to the DCS. These programs extract data values to be used by "MIDWEST," edit them, and write them onto magnetic tapes in binary. These tapes are used as input to "MIDWEST."

"MIDWEST" initially merges input data and converts it into a form acceptable to a program for "sounding analysis," that is, to determine whether a sounding represents conditions that are favorable for the development of thunderstorms which could penetrate the tropopause.

Each "point" in a sounding contains pressure, temperature, relative humidity (converts to dew point) height and tropopause.

TITLE:	Vela Satellite Data Reduction for Solar Space Forecasting	
AUTHOR:	Williams, N.	
INITIATOR:	Cronin, E. (SUYA)	
PROJECT:	000D	PROBLEM NO. 1416
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS; UNIVAC 1108 EXEC 8/ Fortran IV, Fortran V	
MINIMUM CORE SIZE:	50_8k	

Several programs to process Vela satellite data in support of the Solar Space Forecasting program were written in Fortran IV for the DCS and later adapted for use on the Univac 1108.

One effort extracts real-time Vela Satellite Launch III and IV telemetry messages from a variable-length record binary tape recorded at the Satellite Control Facility (SCF), Sunnyvale, California, decodes, edits, processes and stores specific types of instrument data by experiment for further analysis.

Another effort accepts neutron monitor data sorted by program 1, maintains a short-time history of the data as it is processed, determines any significant increases of decreases in the netutron density data and flags these for future analysis and provides calcomp plots of pertinent data and stores historical data for long-term storage.

A third effort processes solar wind data from a preprocessed binary input tape. Bulk velocity, angular temperature, transverse temperature, number density and flow direction are computed. Hourly averages are performed on this data and a hundred-hour active file is maintained.

TITLE: Analysis of Upper Atmospheric Wind Data
AUTHOR: Boudreau, R.

INITIATOR: Pfister, W. (LI)
PROJECT: 8605 PROBLEM NO. 1417

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 77_8k

A three-space antenna recording system has been in operation in Billerica, Massachusetts, since 1965 under the combined direction of the AFCRL Ionospheric Physics Laboratory and Lowell Technological Institute Research Foundation (LTIRF). Amplitude data of ionospheric drift motions, originally recorded in analog form, are subsequently digitized for the purpose of analysis with the use of a large-scale digital scientific computer.

Several programs were written to assist the Ionospheric Physics Laboratory in modular analysis of the turbulence characteristics and structure of the upper atmosphere.

Amplitude and phase data from magnetic tape recordings supplied by LTIRF are printed for each of three antennas for those cases specified by LTIRF.

These phase and amplitude measurements are converted to physical units (decibels and radians), the real and imaginary parts of the complex cross and auto correlations are calculated, and related power spectra are generated. These results are used in the analysis of drift motions of the ionosphere and as input to a model which can be used to define the turbulence of characteristics of ionospheric layers.

Calcomp plots are generated based on the correlation functions and the power spectrum.

TITLE: Sub-Nuclear Phusics
AUTHOR: Harris, S.

INITIATOR: Shickman, A. (PHD)
PROJECT: 8647 PROBLEM NO. 1418

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 40_8k

Certain integrals associated with sub-nuclear physics are computed with formulas supplied by the experimenter.

The integrations are performed by Gauss-Chebyshev-quadrature to avoid most of the difficulties associated with the singularities which are in the range of integration. The regions of the pole are excluded from the integration and double-linear interpolation is applied in this range.

TITLE: Plasma Astrophysics Investigation
AUTHOR: Russell, J.

INITIATOR: Shickman, A. (PHD)
PROJECT: 8647 PROBLEM NO. 1419

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 18_8k

An improper integral was evaluated using the Gauss Laguerre Quadrature method for the evaluation of a problem dealing with plasma astrophysics.

The integral is detailed in the "Scientific Research in the Form of Numerical Analysis and Data Analysis," AFCRL-68-0481, final report.

TITLE: OV1-15 MS II Ram Point Smoothing
AUTHOR: Jacobs, L.

INITIATOR: Philbrick, C. (LKD)
PROJECT: 6687 PROBLEM NO. 1420

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 3_8k

Subroutine "EXPSMO" smooths the IMS spin cycle data to filter out random noise from the OV1-15 MSII experimental data.

A response function "alpha" determines the closeness of the response of the fit to the data. The higher the value of "alpha", which is between 0 and 1, the faster the smoothed data will respond to the real data.

The only requirements for input to the subroutine are: the array to be smoothed, the number of points in the array and an "alpha" value.

TITLE: Magnetic Signatures
AUTHOR: Wright, W.

INITIATOR: Zawalick, E. (PHG)
PROJECT: 8601 PROBLEM NO. 1421

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 22_8k

"POINTS" is a program designed to find the component of a point in a magnetic field "T" when its Y-term is known with respect to another field "F" by using a components analysis of the field "F" along a predetermined director.

Various values of alpha and perpendicular distances are computed for several changes in a starting point.

TITLE: Contour Mapping
AUTHOR: Dabcovich, M.

INITIATOR: Klobuchar, J. (LIR)
PROJECT: 4643 PROBLEM NO. 1422

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 32_8k

The "CONTOR-THEO" program accepts data in either equal or random intervals and displays a contour plotted upon a generated grid, the fineness of which is specified by the user.

Isobars may be ge ·ted at equal intervals by specifying the number of contours over the entire d: · :r at levels determined by the user, or between stated levels at a partic. separation.

The grid is computed from maximum and minimum boundary values and spacing parameters supplied by the user. The contour is made relative to this equal interval data and plotted via the Calcomp.

TITLE: Heated Thermistor Analysis
AUTHOR: Pustaver, J.

INITIATOR: Wagner, W. (LCC)
PROJECT: 6665 PROBLEM NO. 1423

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 26_8k

A spherical thermistor contained within a cylinder of specified dimensions is suspended on four leads. The cylinder is entirely closed, with posts at each end. A wire is attached to these posts and suspended inside. The temperature of the posts and the cylinder walls remain constant.

The program determines the temperatures within the cylinder and along the wire by computing the bead temperature as a function of the heat conductivity of the air inside the cylinder and the geometrical dimensions of the cylindric cavity.

Laplace's equation in mixed coordinates and the equation for heat flow on the wire's surface are approximated by finite difference schemes. The resulting system of difference equations is solved by the Gauss-Seidel iterative process.

TITLE: Aerosol Attenuation Coefficients
AUTHOR: Harris, S.

INITIATOR: Elterman, L. (OPA)
PROJECT: 7670 PROBLEM NO. 1424

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 24_8k

This problem is concerned with the interaction of light with the atmosphere, in particular, the aerosol attenuation coefficient in the troposphere and stratosphere. The coefficient is an important parameter as it describes quantitatively the effects of the aerosol content of the atmosphere on the passage of light. Also because of its proportionality to the aerosol number density, the coefficient provided information concerning aerosol stratification.

Though much emphasis has been placed on aircraft, balloons and rockets obtaining data for this study, this program uses data obtained through a searchlight method.

The primary objective of the program is to produce an atlas of profiles.

TITLE: Conversion of IBM 360 Tapes to DCS - General
AUTHOR: Armstrong, D.

INITIATOR: Smart, D. (PHE)
PROJECT: 8600 PROBLEM NO. 1425

HARDWARE/SOFTWARE: IBM 1460/SPS
MINIMUM CORE SIZE: 10_8k

Tapes generated on the IBM 360/30 computer are reformatted to run on the IBM 7094 II-7044 DCS.

The input tapes contain variable-length records containing incomplete words. These records are reshaped so that they contain a multiple of six characters per word.

Any record length can be modified to contain a maximum of 3999 BCD characters per record.

The program is designed for an 8K 1460 computer that does not have the divide feature.

TITLE:	Radar Trajectory Data Reformatting
AUTHOR:	Hickey, P.
INITIATOR:	Robinson, E. (SUYA)
PROJECT:	0001 PROBLEM NO. 1426
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	14_8k

IBM 1800-computer-generated magnetic tapes are converted to the DCS. Radar data tapes are reformatted as part of the task of analyzing and developing studies of rocket trajectories.

Two files per job are required for the reformatted radar trajectory data tapes. The first file is a header record 12 words long. The second file consists of converted data 9 words per record.

The program was designed to decode multiple input files and minimize the time involved reducing missile range data inputs to usable information.

Output is a table of line count, hours, minutes, seconds, tenths, aux code, seconds after launch, azimuth, elevation and range.

TITLE:	Ice Fog Particles - Size Distribution
AUTHOR:	Spuria, A.
INITIATOR:	Huffman, P. (OPA)
PROJECT:	7621 PROBLEM NO. 1427
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	20_8k

Water vapor and pollutants injected into a low temperature mass of stagnant air provide the raw material for the formation and growth of small ice particles - ice fog.

Here, ice fog particles size distributions are determined mathematically and then compared with those observed under experimental conditions.

Time intervals and interpolated tabular values are printed out. Also output are beginning and ending times and temperatures for each time interval, along with computed droplet radii, rate of formation, and saturation ratio for that time period.

TITLE: Spectroscopic Studies
AUTHOR: Doherty, R.

INITIATOR: Mapleton, R. (LKS)
PROJECT: 8627 PROBLEM NO. 1428

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 20_8k

Quantum mechanical cross-sectional absorption function values are generated as a function of energy.

These values are described by multiple integrals which must be solved numerically, using Gauss-Legendre integration.

In order to obtain three significant digits of accuracy, the intervals of integration are subdivided for piecemeal integration. The number of Gauss-Legendre points used in each subinterval was made variable for the same reason.

A list of pertinent values associated with the integrations is output.

Critical calculations are performed in double precision arithmetic in order to assure the desired accuracy.

TITLE: IBM 360 Tape Reformatting
AUTHOR: Armstrong, D.

INITIATOR: Smart, D. (PHE)
PROJECT: 8600 PROBLEM NO. 1429

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV, SPS
MINIMUM CORE SIZE: 24_8k

A tape containing neutron monitor data was received from the Southwest Center for Advanced Studies. The tape was generated on an IBM 360 model 60 computer. The records on this tape consist of 4000 characters corresponding to 50 BCD cards. The record length was not compatible with the DCS, and hence, the request to make it compatible.

The aforementioned task was accomplished in three steps:

1) A 1460 packing program was run to insure that each record had a multiple of six characters in it, and deficient records were padded with blanks. The raw data tape was blocked onto a computer center tape at this time.

2) The blocked tape was read in and a new tape generated, consisting of BCD card images.

3) The new tape was read and the card images printed out.

TITLE: Aerial Photography Coordinate Rotation
AUTHOR: Wright, B.

INITIATOR: Glass, M. (LYC)
PROJECT: 8620 PROBLEM NO. 1430

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 2_8k

Aerial photograph information and orientation of the airplane are input to a program computing the coordinates of the photo-system in the earth system.

If the plane's altitude is to be given in displacement, a deck of calibration cards is read in. If the height of the plane is to be computed from the recorded pressure, constants for the height-pressure equations are input. The X, Y, Z coordinates in the photo-system are then computed, and a coordinate notation is made to give the coordinates in the earth system. These coordinates are then scaled according to the known height of the airplane. For convenience in plotting, the x-y distance from the origin is computed as well as the scaled map distance.

TITLE: Velocity and Temperature Measurements for Meteorological Studies
AUTHOR: Mazzio, V.

INITIATOR: Wyngaard, J. (LYB)
PROJECT: 7655 PROBLEM NO. 1431

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 17_8k

Turbulent velocity and temperature fields can be considered to be made up of Fourier modes of all wave numbers travelling in all three coordinate directions. Any instrument used to measure velocity or temperature fluctuations has spatial averaging characteristics, so that modes of certain wave numbers and certain directions are attenuated. It is necessary to know these average characteristics in order to interpret correctly the instrument outputs. In the case where the instrument averages over a linear path in isotropic turbulence, the measured one-dimensional power spectral density is related to the time one-by-two dimensional integrals over wave number space. This program evaluates these integrals.

TITLE: Doppler Frequency Analysis
AUTHOR: Atkinson, J.

INITIATOR: Hadgigeorge, G. (LWG)
PROJECT: 7600 PROBLEM NO. 1432

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 5_8k

Certain Doppler data values are read from an input tape, and some of these values are adjusted in order to create new tapes. The base and received frequencies are taken and converted to range rate. Two tapes are converted in this way.

Output is the station number, satellite number and time of observation onto the new tape.

TITLE: Conversion of CDC 3600 Format Tape to DCS
AUTHOR: Chin, J.

INITIATOR: Shea, M. (PHE)
PROJECT: 8600 PROBLEM NO. 1433

HARDWARE/SOFTWARE: IBM 1460/SPS
MINIMUM CORE SIZE: 3_8k

A "Swedish Data Tape" is reformatted on the IBM 1460 Computer. The tape was generated originally on the CDC 3600 Computer, and had to be made compatible for use on the IBM 7094 II-7044 DCS.

The reformatting is accomplished by breaking each input record into 33 smaller records of 84 characters in length. The original data records contained 33 sets of information of 152 characters each. Two output tapes were required because of the vast amount of data.

TITLE: OV3-6 Ephemeris and Data Merge (60-Segment)
AUTHOR: Chin, J.

INITIATOR: McIsaac, J. (LKB)
PROJECT: 6688 PROBLEM NO. 1434

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV, MAP
MINIMUM CORE SIZE: 10_8k

The Seg60-Merge program was written to merge a 60-segment commutator data tape from the OV3-6 Satellite with an ephemeris tape. The resulting binary output tape is to be used in the data reduction analysis of the information gathered from the experimental instruments of the vehicle.

The data records are unpacked a frame at a time into 60 segments and a range time. These segments are converted to volts and the 5-clock segments are checked for bad or missing clocks by checking for irregular range time jumps. The ephemeris data is synchronized to the data tape information through the GMT time.

TITLE: OV3-6 Ephemeris and Data Merge (40-Segment) Commutator Data Merge
AUTHOR: Williams, D.

INITIATOR: Philbrick, C. (LKC)
PROJECT: 6687 PROBLEM NO. 1435

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 22_8k

Ephemeris information is interpolated and merged with OV3-6 mass spectrometer data. Universal time is generated, an output merge tape is written, and a listing of time and selected ephemeris values is printed.

TITLE: OV3-6 PCM and Ephemeris Tape Merge
AUTHOR: Chin, J.

INITIATOR: Ulwick, J. (LIJ)
PROJECT: 7663 PROBLEM NO. 1436

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV, MAP
MINIMUM CORE SIZE: 10_8k

The PCM-MERGE program was written to merge an OV3-6 PCM data tape with an ephemeris tape. The resulting binary merged tape containing the plasma frequency and electron temperature data from the PCM tape and the ephemeris data is to be used in the data reduction analysis of the information gathered from the experimental instruments attached tot the OV3-6 Satellite.

The PCM data record is unpacked one frame at a time into a range time, on-board time, 14 plasma frequencies, 14 electron temperatures and a frame sync word. If the rev is a playback rev, the range time of each frame of data is checked for irregular time jumps; if the rev is real time, then the on-board time is used.

TITLE: OV3-6 Quick-Look Print and Plot
AUTHOR: Fusco, R.

INITIATOR: McInerney, R. (SUYA)
PROJECT: 0001 PROBLEM NO. 1437

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 16_8k

The "GLP 36" program was written to provide a means of examining the telemetry data from the OV3-6 Satellite.

"GLP 36" retrieves real-time and playback commutator data and transforms the telemetry data to voltages for each segment. Several options are available, as follows:

The program

a. can process multiple files of data.

b. can list any data point by reading in the various pin locations on a data card.

c. can print any header record by reading in data cards.

d. has a list option.

e. has the option to plot various parameters.

f. has a thinning option (to skip records).

TITLE:	OV1-15 MSII Angle of Attack Corrections	
AUTHOR:	Williams, D.	
INITIATOR:	Philbrick, R. (LKD)	
PROJECT:	6687	PROBLEM NO. 1438
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	56_8k	

The ratio of currents at different attack angles to the current at the minimum attack angle is computed for OV1-15 orbits with low attack angles. The ratios obtained would form the basis for correcting orbits with high attack angles, and also for correcting scan data at high attack angles.

Input to the program is an OV1-15 MSII Ion Mode Tape and an OV1-15 aspect tape.

Output consists of the input mode determination tape header record, ephemeris and aspect values, ion current and time values, and the angle, current and ratio values for each spin cycle.

TITLE:	OV3-6 Ion Density Gauge Data Reduction	
AUTHOR:	Markey, A.	
INITIATOR:	McIsaac, J. (LKB)	
PROJECT:	6690	PROBLEM NO. 1439
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	44_8k	

The purpose of this program is to process OV3-6 merged data tapes. The program computes the ion trap current, gauge temperature, amp temperature, high voltage, nitrogen pressure I and II, helium pressure I and II, and oxygen pressure I and II for each commutator revolution. The output, in addition to the above, includes Greenwich Mean Time, local time, altitude, velocity, geodetic latitude and longitude, attack angle, and range time for each commutator revolution. Also, plots of G.M. Time vs nitrogen pressure 1, G.M. Time vs attack angle, and attack angle vs oxygen pressure 1 are produced.

The program can process multiple orbits, which are then merged onto the same tape.

TITLE:	OV3-6 PAM Impedance Probe	
AUTHOR:	Fusco, R.	
INITIATOR:	Ulwick, J. (LIJ)	
PROJECT:	7663	PROBLEM NO. 1440
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	10_8k	

The PAM Impedance Probe program is designed to reduce the OV3-6 Impedance Probe experimental data.

The impedance probe has outputs on nine pins of the sixty-segment commutator. The data consists of either the plasma frequency or electron temperature measurement and each is plotted vs time.

Input to this program is in the form of blocked, binary, OV3-6 merged tapes and appropriate process control cards.

TITLE:	Extraction of Subcommutator Data (OV1-15)	
AUTHOR:	Conway, E.	
INITIATOR:	McInerney, R. (SUYA)	
PROJECT:	0001	PROBLEM NO. 1441
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	3_8k	

The purpose of "PCM SUB COM" is to read a merged PCM type of telemetry tape and extract the subcommutator data from the PCM portion of the merged record. It was originally designed to be used for the OV1-15 Satellite, but could be modified to process data from other vehicles with similar PCM characteristics.

The input data contains a header record followed by records, each consisting of 5 60-segment commutator revolutions, interpolated ephemeris data, satellite aspect data and data obtained pertinent to the satellite aspect.

TITLE: Merged Data Quality Check (OV3 Satellite Series)
AUTHOR: Williams, D.

INITIATOR: McInerney, R. (SUYA)
PROJECT: 0001 PROBLEM NO. 1442

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 17_8k

The quality of the merged data for the OV3 series of satellites is verified. Elapsed range time is compared to elapsed universal time and elapsed clocks. If they don't agree, appropriate data is printed out for correction. The quality of the ephemeris data is also checked.

Certain words on all merged records may be printed, and, if desired, OV3-1, OV3-2 and OV3-6 merge tapes can be processed.

The program could be expanded to process other merge tapes.

TITLE: Solar Radio Emission Data Reduction
AUTHOR: Spuria, A.

INITIATOR: Barron, W. (LIR)
PROJECT: 5629 PROBLEM NO. 1443

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 43_8k

Modifications were made to problem number 1363 to allow the program to process up to ten arbitrary frequencies rather than five fixed frequencies called for in the original program requirements.

The program processes data recorded during the observation of solar radio emissions at various frequencies. The data contains distinctive event flux values, daily flux values and minute-by-minute flux values.

Least-square polynominal fits were made of the logs of the frequencies of flux values. For each group of data points the polynominal coefficients and a measure of goodness-of-fit (as well as a comparison of flux values to their appropriate polynominal values) are provided. The results are plotted via the Calcomp.

TITLE: Satellite Observability
AUTHOR: Kellaher, J.

INITIATOR: Cronin, E. (SUYA)
PROJECT: 0001 PROBLEM NO. 1444

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 63_8k

"MINVIS" determines and records the time intervals during which an earth satellite is observable from an optical observation station on the earth. It may be used to aid in selecting from a set of stations those which should be alerted for the observation of a particular satellite.

The three elements -- time, a satellite, and an observer -- are represented by the three general classes of inputs, (a) a time interval of 200 days or less during which observability is investigated, (b) a satellite orbit, as given by an epoch and a set of orbital elements, (c) geographic coordinates and other data for a set of observation stations, sixty or less of them. In this program, "observability" is not simply a matter of a line-of-sight between the station and the satellite; it involves also the position of the sun in relation to the station.

TITLE: OV1-15 Mass Spectrometer Data Processing
AUTHOR: Conway, E.

INITIATOR: Philbrick, C. (LKD)
PROJECT: 6687 PROBLEM NO. 1445

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 32_8k

OV1-15 mass spectrometer (MS) data is read from tape, and the applicable masses of interest and the height at which the reading was taken are retrieved.

When the tape has been completely searched, and the masses properly classified as to type and as to whether they occur before or after perigee, the masses are interpolated to values at the heights at which mass 16 (oxygen) observations occurred.

The percentages of the various atmospheric masses at the specified heights are calculated and plotted out versus the log of the altitude. The plots contain other information of interest, such as run data and perigee information, also.

TITLE: Precipitation Prediction
AUTHOR: Shea, E.

INITIATOR: Lund, L (LKI)
PROJECT: 8624 PROBLEM NO. 1446

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 53_8k

Applications of stagewise and stepwise correlation and screening regression techniques were used to estimate future rainfall precipitation in the San Joaquin Valley in California. Geopotential height data obtained from the Air Force Global Weather Central and precipitation data from the San Joaquin and Sacramento Valley area were used in the study. Predictors are heights, vorticities and thicknesses at 499 grid points for 424 days (January 1 through February 22 for the years 1962 through 1969).

Included in the output is a list of the values of four predictors, and input precipitation, the predicted precipitation, the error function and eight sets of correlation coefficients at each of the 499 stations corresponding to 850, 500, 200-850, 200-500, 500-850 millibar heights and vorticity data.

TITLE: Master Serials File Updata
AUTHOR: Roehrig, H.

INITIATOR: Sievers, P. (SUOL)
PROJECT: 0004 PROBLEM NO. 1447

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV, MAP
MINIMUM CORE SIZE: 10_8k

Several programs were written in order to create a file maintenance system for the AFCRL Research Library. The maintenance system concerns serial publications and includes such functions as sorting, editing, updating and listing of master serials library file and a master active titles file.

Some of the output created by the system includes'

a. An updated master serials file on magnetic tape.

b. A subscription order summary.

c. An "Errors and Comments" report.

d. Listing of accounts containing Library of Congress call numbers.

e. Ordered list of class 3 holdings (order-receipt) cards.

TITLE: OV1-15 MSII Ion "F" Region Density Plot
AUTHOR: Desrochers, R.

INITIATOR: Philbrick, C. (LKD)
PROJECT: 6687 PROBLEM NO. 1448

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 36_8k

The OV1-15 MSII Ion "F" Region Density program was written to provide a means of rapid analysis of the experimental data from the mass spectrometer instruments on the OV1-15 Satellite.

This program is used to produce a plot of MSII ION Density vs Altitude. The input to this program is in current form (amps). The values are converted and normalized to density (IONS/cm^3), and plotted against altitude. An "F" region conversion factor is used to transform the data. A different factor is required for each orbit.

TITLE: OV1-15 MSI Neutral Correction
AUTHOR: Markey, A.

INITIATOR: Philbrick, C. (LKD)
PROJECT: 6387 PROBLEM NO. 1449

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 3_8k

Subroutine "SPRINT" was written to replace a time-consuming integrating subroutine, and calculates the function F (s cos ϕ) by interpolation of previously calculated tables.

F (s cos ϕ) represents a factor used to calculate the rate at which molecules of gas enter a satellite chamber when the orifice points into the airstream. This function depends upon the speed ratio s and the angle ϕ between the velocity vector and the normal to the orifice.

TITLE:	Starrad Data Merge	
AUTHOR:	Delmonico, R.	
INITIATOR:	Kuck, G. (PHE)	
PROJECT:	8600	PROBLEM NO. 1450
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	45_8k	

The Starrad Merge program interpolates ephemeris information, and merges this information with experiment data.

Input are a floating point binary tape and the ephemeris BCD tape containing certain satellite and station observation information.

Output consists of a printed message, giving either the revolution number of the orbit that had been merged, or an error message. Output also is a Starrad merged tape containing three logical record formats per orbit.

TITLE:	Meteor Trail Winds	
AUTHOR:	Atkinson, J.	
INITIATOR:	Barnes, A. (LYU)	
PROJECT:	8628	PROBLEM NO. 1451
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	40_8k	

Data obtained from the echo from meteor trails is used to determine the approximate means of wind speed and direction. The distance over which the meteor was traced versus the wind speed and versus the wind direction is plotted.

Two 20" x 30" plots are output using 2500 cards of input.

TITLE: Calculation of Molecular Constants
AUTHOR: Russell, J.

INITIATOR: Takezawa, S. (LKS)
PROJECT: 8627 PROBLEM NO. 1452

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 30_8k

As certain molecular particles are excited they give off energy and tend to fall from a higher energy to a lower energy state. This program was produced to aid in the determination of those constants which determine what energy state the molecules under consideration attained. The results were then compared to experimental spectroscopy data.

The program finds the value of a particular parameter which minimizes the sum or difference of the squares of two series produced from a least-squares analysis.

TITLE: Ionospheric Drifts
AUTHOR: Grossbard, N.

INITIATOR: Elkins, T. (LIR)
PROJECT: 4643 PROBLEM NO. 1453

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV, MAP
MINIMUM CORE SIZE: 73_8k

Various parameters of the ionospheric drifts were derived from the results of cross-correlation computations. Several programs were written to inspect the Fourier power spectra as well as to analyze cross-correlation and auto-correlation functions.

The log (integral (power spectrum)) versus the frequency is plotted via the Calcomp.

TITLE: Dielectric Constants of Polycrystalline Ceramics
AUTHOR: Russell, J.

INITIATOR: Sethares, G. (LRA)
PROJECT: 4641 PROBLEM NO. 1454

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 4_8k

As a necessary step in determining dielectric constants of certain polycrystalline ceramics, this program was written to exhibit the constrained zeros of a transcendental function involving Bessel functions of order zero and order one.

The program outputs a listing containing the following: The bounds or conditions for evaluating the constrained zeros or roots of the function and the three cases which determine under what conditions the zero of the function may or may not exist.

TITLE: Location of Ionospheric Disturbances
AUTHOR: Martine, J.

INITIATOR: Ganio, A. (LII)
PROJECT: 5631 PROBLEM NO. 1455

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 41_8k

A transcendental equation is solved in order to determine the latitude and longitude of an ionospheric disturbance from the times of arrival of disturbance-related signals at three ground stations whose geographic coordinates are known.

Several simplifications are made, as follows: The earth is considered to be perfectly spherical; a ground level disturbance generates a signal which travels with uniform speed along all paths; various ground stations pick up the signal in perfect time sync.

The results consist of either (1) a comment that no solution existed, or (2) values for the coordinates of the ionosphere disturbance and the resulting values for the ratio $\frac{\text{"V"}}{\text{E}}$ for each station (where "V" equals the speed of travel of the signal and "E" equals the earth's radius).

TITLE: Electron Density Data Processing
AUTHOR: Boudreau, R.

INITIATOR: Markham, T. (OPR)
PROJECT: 5710 PROBLEM NO. 1456

HARDWARE/SOFTWARE: CEC 6600/Fortran IV
MINIMUM CORE SIZE: 76_8k

The intensity of the night airglow emission (6300 Å OI) of the F layer of the ionosphere was calculated from electron density data gathered at various heights of the ionosphere.

In addition to the calculated spectral emission intensity, pen and ink plots were generated of (1) intensity vs time at constant specified temperatures, (2) log (intensity) vs time at the same specified temperatures, (3) height vs intensity at specified constant times and temperatures and (4) height vs intensity "trough" for each data set.

TITLE: Many-Body Interaction
AUTHOR: Russell, J.

INITIATOR: Eyges, L. (LQD)
PROJECT: 5621 PROBLEM NO. 1457

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 22_8k

The "EYG" computer program was written to calculate and graph a function which involved two improper integrals. The function involved is required in the analysis of the "many-body problem," that is, how and in what way two or more bodies interact. This function was evaluated for several values of the parameter λ, a parameter of conductivity.

"EYG" generates a listing of the value of the function (mentioned above) for continuous changes in distance and for various values of λ. Concomitant graphs of the function are also displayed.

Simpson's rule was used to evaluate the two improper integrals.

TITLE:	OV1-15 MSI Neutral Data Processing
AUTHOR:	Desrochers, R.
INITIATOR:	Philbrick, C. (LKD)
PROJECT:	6687 PROBLEM NO. 1458
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	32_8k

Two subroutines aid in the processing of OV1-15 Satellite MSI neutral data.

"GPLOT", the general plotting subroutine, was written to facilitate the inclusion of plotting capabilities within a program. The subroutine can produce both CRT and paper plots. Multiple axes, headings, log scales, etc., all can be requested with a maximum of three calls to this subroutine. Additional plots can be provided with only two calls.

"SMODIF" was written to smooth experimental satellite data. The characteristics of this data should be such that short variations and fluctuations in the data are caused by random effects, and are not significant to the true data. This subroutine will smooth the variations, and at the same time, retain the overall space of the curve formed by the original data.

Smoothing was accomplished using the method of 4th and 6th differences of weighted points (5 or 7).

TITLE:	Analysis of Wind Gusts and Their Duration
AUTHOR:	Atkinson, J.
INITIATOR:	Gringorten, I. (LKI)
PROJECT:	8624 PROBLEM NO. 1459
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	73_8k

The Boundary Layer Branch, Meteorology Laboratory of AFCRL, has been conducting a project known by the code name "Windy Acres," which in the summary of 1967, resulted in magnetic-tape records of windspeeds at heights of 0.5, 1.0, 2.0, 4.0, 8.0, 16.0, 24.0 and 32.0 meters above ground, on an instrumented tower located about 35 miles northwest of Liberal, Kansas. In 1967, the windspeeds were recorded at 1-second intervals throughout each of 40 individual hourly periods, thus making 3600 observations of windspeed per hour.

These records provided a basis for analyzing gusts, to obtain their distribution classified according to the duration of gusts and height above the ground. The method used in this analysis was the study of minimum and average windspeeds over different time intervals.

The duration of each one-second wind speed was measured through the process of cumulative frequencies for eight different levels on the tower. Output consists of the cumulative frequencies for each speed from .1m to 30m.

TITLE: Solar Radio Burst Curves at Specific Frequencies
AUTHOR: Spuria, A.

INITIATOR: Barron, W. (LIR)
PROJECT: 5629 PROBLEM NO. 1460

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 36_8k

The area under the flux (solar radio burst) curves at several specific frequencies, ranging in number from one to seven, is computed for one or more proton events, where the readings are taken at one-minute or one-tenth-minute intervals. For each frequency, the area is taken under the flux versus time curve. If points are missing, linear interpolation is used between the two closest points. The number of non-zero one-tenth-minute intervals of integration is also provided so that a relative potential can be calculated. The integration uses the Trepezoidal Rule.

TITLE: Solar and Lunar Ephemeris
AUTHOR: Almon, A.

INITIATOR: Hussey, I. (SUYA)
PROJECT: 0001 PROBLEM NO. 1461

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 26_8k

Two ephemeris programs modify "SOLAR" and "LUNAR" of Problem No. 1131. Solar and lunar ephemerides are produced from basic quantities, and no input data other than that necessary to describe a particular ephemeris run is required.

The user can specify any station location and times of computation with a selected time step. Also, the user can select the maximum elevation cut-off as well as the minimum to be computed and listed as output.

T... r and lunar ephemeris programs were converted for use on the CDC 6600. In addition, the converted programs output the azimuth and elevation (refracted and unrefracted) for each time period.

TITLE:	Solar Zenith Angle Plot
AUTHOR:	Birtwell, R.
INITIATOR:	Toman, K. (LII)
PROJECT:	5631 PROBLEM NO. 1462
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	25_8k

Solar zenith angles (cosine of angles) are plotted versus time for every tenth day for 1965 and 1968 from data received from three sites by two different programs.

The first program reads a binary tape and selects the cosine of zenith angles, time, and date. The time is converted from Universal Time to Eastern Standard Time, and the plots are made one station and year at a time.

The plots are generated at the rate of one per day.

The second program differs from the first in that the time remains Universal Time and the year is divided into four-month sections.

TITLE:	Riometer Data Plot
AUTHOR:	Spuria, A.
INITIATOR:	Cormier, R. (LII)
PROJECT:	5631 PROBLEM NO. 1463
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	25_8k

Riometer data sets are plotted versus sidereal time. The data can be plotted in terms of any of three eight-hour periods or the entire day for any group of days.

The abscissas are in terms of Sidereal Time, corresponding to whole hours of Universal Time. Station, year and month are indicated on each plot.

TITLE:	Daily Sunspot Numbers Plot	
AUTHOR:	Dolan, J.	
INITIATOR:	Toman, K. (LII)	
PROJECT:	5631	PROBLEM NO. 1464
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	10_8k	

Calcomp plots were created in order to analyze daily sunspot activity for the years 1940 to 1966.

Daily sunspot numbers are input 20 per card. The x-axis on the plot is labeled from 0.0 to 400.0 in increments of 50.0, which represents 1mm/day for each sunspot number. The y-axis is half as long and has the same starting and end values.

TITLE:	Lunar Coordinate Refinement	
AUTHOR:	Dieter, K.	
INITIATOR:	Eckhardt, D. (LWG)	
PROJECT:	8607	PROBLEM NO. 1465
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV	
MINIMUM CORE SIZE:	116_8k	

A method is studied for the estimation of the dynamic and geometric figures of the moon from lunar plates which are photographed from the earth. Primarily, the study concerns a statistical technique for the estimation of two independent physical libration constants and, consequently, for the estimation of a first-order dynamic figure of the moon. In the same reduction, the relative locations on a number of control points on the moon's surface are also estimated. The control points are samples of the true lunar surface, so that a simple geometric surface fit to these points is a low-order or smooth model of the geometric figure of the moon.

The procedures used in the program to refine lunar coordinates can also be employed to analyze similar data for landmarks on the surface of the earth as seen, for example, from the moon or an earth satellite.

A matrix is set up and inverted. The inverse matrix is multiplied by a vector, forming a new vector, which is corrected, checked for convergence, then multiplied by the matrix. This iterative process continues until the convergence criteria are satisfied.

The crater coordinates, the plate angles, and the libration parameters are printed as soon as convergence appears.

TITLE: Field Searchlight Scatter Measurements
AUTHOR: Harris, S. and Persakis, T.

INITIATOR: Elterman, L. (OPA)
PROJECT: 7670 PROBLEM NO. 1466

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS; CDC 6600/Fortran IV
MINIMUM CORE SIZE: 35_8k

A knowledge of atmospheric aerosol properties is necessary for the solution of many research and applied problems, for example, transmission, visibility, astronomical seeing, meteorological tracing and turbulence. In nearly all of the problems concerned with the interaction of light with the atmosphere, the aerosol attenuation coefficient emerges as an indispensable and little-known parameter. The purpose of this task was to determine quantitatively this and related parameters using the searchlight technique, which involved taking light-scattering measurements from a searchlight beam in New Mexico.

A program was written to adjust, reduce and plot this searchlight data. The input profiles are scanned for correctness; then, according to the adjustment code, they are adjusted for discontinuities caused by gain changes in the equipment and/or rotated to adjust the zero shift in the equipment.

Each profile type is plotted with normalized response versus altitude in kilometers.

Both the original DCS version and the CDC version of this program have been retained and are available for use.

TITLE: OV1-15 Exospheric Temperatures
AUTHOR: Erickson, P.

INITIATOR: Philbrick, C. (LKD)
PROJECT: 6687 PROBLEM NO. 1467

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 61_8k

The exospheric temperatures encountered by the OV1-15 satellite were determined through the use of the MSI neutral hydrostatic equation. Interpolated values for parameters (local time, latitude, longitude and angle of attack) representing changes in vehicle altitude of five kilometers are obtained prior to calculation of the temperatures. The equation used to obtain the temperatures is:

$$\frac{dI}{dh} = \frac{I}{T}\left(\frac{M \cdot G}{K} + \frac{dT}{dh}\right)$$

where I = current value
T= 679.5°K at altitude 160,000 M
M=mass of gas being used
K=Boltzman's constant
G= force of gravity

TITLE:	Computation of Cubic Roots of a Polymonial	
AUTHOR:	Doherty, D.	
INITIATOR:	Kriger, L. (LRS)	
PROJECT:	4610	PROBLEM NO. 1468
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV	
MINIMUM CORE SIZE:	4_8k	

"Cubic-1" calculates the real and two complex roots of a cubic equation with variable coefficients. Sixteen sets of four coefficients each are input, but the program can be modified to allow an unlimited number of sets as input.

The real root is found using a "false-positioning" method. Once this root is found, the equation is divided by the monomial (with the real root as its constant term) leaving a quadratic. The quadratic is solved using the quadratic formula. Double precision is employed in several calculations.

TITLE:	Determination of Wind Velocity and Direction	
AUTHOR:	Pustaver, J.	
INITIATOR:	Hawkins, R. (LYS)	
PROJECT:	6698	PROBLEM NO. 1469
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	45_8k	

Wind velocity and wind direction within a rectangular portion of the earth's surface are calculated for given direction, with the velocity values at one-degree intervals on the boundary of the rectangle.

When direction and velocity are known for grid points within the rectangle, these known values can be incorporated into the problem in order to influence the results.

The program was written to accommodate data from the eastern hemisphere.

The boundary conditions are converted from polar coordinates, direction and velocity, to rectangular coordinates, U and V. A five-point finite difference scheme is used to solve Poisson's equation in the U and V direction. The finite difference equations are solved by the Gauss-Seidal method.

TITLE: OV1-15 MSI Neutral Temperature Analysis
AUTHOR: Williams, D.

INITIATOR: Philbrick, C. (LKD)
PROJECT: 6687 PROBLEM NO. 1470

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 20_8k

Atmospheric temperatures are computed from experimental data gathered by the OV1-15 satellite. The peak or maximum value of a gas, nitrogen, is determined for altitudes from 500 km down to 150 km, and back up to 500 km.

The atmospheric temperature is computed on the basis of the changes in current and altitude.

The equation used to compute temperature is:

$$\frac{dT}{dH} = -\frac{T}{I}\frac{dI}{dH} - \frac{mg}{K}$$

where T = temperature
H = altitude
I = current
m = mass number
g = acceleration
K = Boltzman's constant

TITLE: Travelling Ionospheric Disturbances
AUTHOR: Dieter, K.

INITIATOR: Klobuchar, J. (LIR)
PROJECT: 4643 PROBLEM NO. 1471

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 77_8k

A previous program analyzed the total electronic content (TEC) as measured by satellite no. 899. The program described herein was written to detect the presence, if any, of travelling ionospheric disturbances, which normally are less than 1% of the TEC. After relevant calculations were made, the results were plotted on the Calcomp Microplotter, thereby enabling the investigator to inspect manually the individual satellite passes for evidence of any disturbances.

The processing involves a least-squares polynomial curve fit to the points representing total electron content versus latitude measured from the observing station (42.63° latitude).

TITLE: Analysis of Radar Echoes
AUTHOR: Armstrong, D.

INITIATOR: Grantham, D. (LKI)
PROJECT: 8624 PROBLEM NO. 1472

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 25_8k

Least-square regression polynomials of degrees one and two are found to determine the pulse height of the radar echo versus the range from site.

This task is performed separately for several different stations over a period of several years, and for all data taken together.

Data is in separate groups according to month/year codes and stations. Each data card contains range, height, and frequency of observations at the particular height and range. The coefficient of correlation for this data is calculated as well as the variance of the heights, and these values are printed out.

Also, the least-square regression line and its standard error of estimate, and the least-square parabola and its standard errors are calculated and written.

The program is part of a climatological task to determine relationship between radar echoes and future weather events.

TITLE: Scintillation Graphs for Canary Bird Satellite
AUTHOR: Chin, J.

INITIATOR: Whitney, H. (LIR)
PROJECT: 4643 PROBLEM NO. 1473

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 55_8k

The scintillation pattern over long periods is determined from data collected from the Canary Bird satellite. The scintillation index observations are taken at definite intervals of time and range from 0 to 100%. The readings are averaged every half hour, hour or at whatever interval of time gives a clear pattern.

At present, the output from this program is a graph of the averages of the scintillation index readings. The graph is continuous, and groups two months of data at a time. These graphs are being studied to determine if it is feasible to construct isopleths from the data.

TITLE: Screening Regression
AUTHOR: Armstrong, D.

INITIATOR: Chmela, A. (LYW)
PROJECT: 6672 PROBLEM NO. 1474

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 13_8k

Correlation coefficients and screening regression equations were calculated for three variables contained on two magnetic tapes.

The two magnetic tapes are read in, pertinent data is extracted, and a new tape, consisting of records with words of the form Y_o, a_o, b_o, c_o, is created. This procedure is done for each variable set, and the new tape is then run through a program which creates a coefficient matrix and subsequently run through a screening regression program which selects the best predictor.

TITLE: Wind Analysis Program Conversion
AUTHOR: Chin, J.

INITIATOR: Pazniokas, J. (LYU)
PROJECT: 8628 PROBLEM NO. 1475

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 30_8k

Two programs were modified for use on the IBM 7094 II-7044 DCS.

The program "WIND" was used for the reduction of log-periodic data. A wind data tape (log period tape) is read, and each record is unpacked into either 210 data words or an hour change record. Certain values of the data are processed and the resulting output is in the form of punched cards. These output cards may have time incongruencies, which can be corrected by the second program, "LOG."

"LOG" adjusts the time on the input cards produced by "WIND" if necessary, and punches out a corrected deck of cards.

TITLE:	Spectral Analysis of Electroencephalograms	
AUTHOR:	Dieter, K.	
INITIATOR:	Dewan, E. (LRS)	
PROJECT:	5628	PROBLEM NO. 1476
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	77_8k	

This program was written primarily to test the hypothesis that external stimuli of a periodic nature (for example, a flashing light) can entrain (or impose) their frequencies upon human brain waves. The important idea here is that such entrainments are of a nonlinear nature.

The experimental data consisted of electroencephalographic waves recorded on magnetic tape. In general, the program allows either experimental data or artificially generated data to be processed.

Cross-correlation coefficients are computed and a Fast Fourier transform based on the Cooley-Tukey algorithm is performed on these coefficients. The results are plotted via the Calcomp.

TITLE:	Orbit Data from an OGO-E Satellite	
AUTHOR:	Twitchell, P.	
INITIATOR:	Sagayln, R. (LIF)	
PROJECT:	8617	PROBLEM NO. 1477
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV, MAP	
MINIMUM CORE SIZE:	55_8k	

Program "PLOD" plots specific orbit data as a function of time from an OGO-E satellite. The data, which includes negative amplifier, positive amplifier, positive monitor, negative monitor, and scan position, is set up into arrays to be used by subroutines "UNPK" and "GRAPH," which produce the actual plots.

Subroutine "UNPK" unpacks the data words contained on the OGO-E data tape into milliseconds of day, accumulated time, status field 1, positive amplifier. negative amplifier, negative sensor, scan position, and day of year.

Subroutine "GRAPH" produces Calcomp plots of negative amplifier, positive amplifier, negative monitor, positive monitor, and scan position as a function of time.

TITLE:	Plots of Rocket Exhaust Doppler Data	
AUTHOR:	Grossbard, N.	
INITIATOR:	Conley, T. (LIJ)	
PROJECT:	7663	PROBLEM NO. 1478
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV, MAP	
MINIMUM CORE SIZE:	23_8k	

Radar doppler readings of a rocket exhaust contained on magnetic tape were plotted versus time for further analysis.

Since the data was packed and since only certain data was desired, routines were written in machine language to unpack the data and select the data needed for plotting.

The program plots the last 200 points of each group of 40000 points. In this respect the program is restricted to the particular task; however, some of the unpacking routines can be used in a general way.

TITLE:	OV1-15 Neutral Absorption-Desorption Analysis	
AUTHOR:	Markey, A.	
INITIATOR:	Philbrick, C. (LKD)	
PROJECT:	6687	PROBLEM NO. 1479
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	32_8k	

The effect of adsorption on densities measured by orbiting pressure gauges on the OV1-15 satellite is investigated by processing the mass-spectrometer data.

"AD-DE" reads a preprocessed OV1-15 mass-spectrometer data tape, and certain calculations are performed for the spin cycles. Listed are different variables, such as internal pressure, external pressure, fractional surface coverage, time, aspect, current, influx, efflux, adsorption, desorption, attack angle, and internal temperature, which demonstrates the effects of adsorption on densities measured by orbiting pressure gauges.

In addition, plots of (1) theta versus aspect, (2) pressure versus Greenwich Meridian Time (GMT), (3) adsorption versus GMT, (4) desorption versus GMT, (5) efflux versus GMT, and (6) influx versus GMT are produced.

TITLE:	Snapshot Plasma Probe Data Processing
AUTHOR:	Lemone, K.
INITIATOR:	Sagalyn, R. (LIF)
PROJECT:	8617 PROBLEM NO. 1480
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	23_8k

The "FLUXSNAP" program was written to calculate positive and negative fluxes from telemetry data transmitted from the Plasma Probe experiment flown on the SNAPSHOT satellite. The "FLUXSNAP" program reads in merged data-ephemeris information, converts this data to electron and ion currents and then calculates electron and ion flux.

A binary tape is output for further analysis of calculated data, and Calcomp plots, containing raw input data, calculated flux, and associated ephemeris parameters, are produced.

TITLE:	Far-Field Seismic Calculations
AUTHOR:	Doherty, R.
INITIATOR:	Thomson, K. (LWW)
PROJECT:	7639 PROBLEM NO. 1481
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	70_8k

Seismologists are assisted in the numerical evaluation of a number of formulas which present a mathematical model of the longitudinal, transverse and tensile far fields.

"FARF" calculates "far-field" formulas for a number of field points. The results give a better appreciation of the mathematical modeling of the seismic phenomenon.

The program generates discrete displacement values as a function of time between minimum and maximum "activity" times at a predetermined time increment. The three components of the displacement function are described by simple trigonometric equations, and the velocity and acceleration are described in simple formulas.

The output consists of tables of the above-mentioned formulas evaluated at significant field points. The output data can be used as limiting values for the "near-field" models.

TITLE:	Electron Density Correlations with Lags
AUTHOR:	Friedman, M.
INITIATOR:	Rush, C. (LII)
PROJECT:	000D PROBLEM NO. 1482
HARDWARE/SOFTWARE:	CDC 6600/ Fortran IV
MINIMUM CORE SIZE:	50_8k

Ionograms, consisting of electron density vertical profile data gathered at various radar stations, are input from tape in arrays of 42 elements, which consist of electron data at 42 altitudes. The first entry is the maximum electron density. The remaining elements consist of electron density readings at altitudes 100 km through 500 km, at 10-km intervals.

Correlations at prescribed altitudes and prescribed lags are computed for each array. Specific altitudes to be used in the correlation calculations are selected and printed out, along with information as to which altitudes are being correlated.

The purpose of this study is to determine the structure of the ionosphere.

TITLE:	Analysis and Reduction of 0V1-15 Solar Magnetic Aspect Data
AUTHOR:	Pruneau, P.
INITIATOR:	McInerney, R. (SUYA)
PROJECT:	0001 PROBLEM NO. 1483
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	44_8k

The ANGLES 0V1-15 computer program was written to implement the aspect analysis in order to compute meaningful aspect parameters for the 0V1-15 satellite, which was launched from Cape Kennedy, Florida, on 11 July 1968.

This program utilizes merged data tapes, containing ephemeris data and the corresponding experiment data for assigned orbits, to compute the aspect parameters. These aspect parameters include the aspect (with respect to a fixed coordinate system in space) of several probe vectors attached to the spacecraft. The aspect parameters also include the angles of attack of the spin axis vector, and of each of the probe vectors mentioned above, with respect to the vehicle velocity vector, the earth's magnetic field vector and the sun-line vector.

These aspect parameters are output in a listing and onto a binary tape.

TITLE:	OV1-15 Solar Magnetic Aspect Data Analysis
AUTHOR:	Pruneau, P.
INITIATOR:	McInerney, R. (SUYA)
PROJECT:	0001 PROBLEM NO. 1484
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	45_8k

The "ATTACK" program was written to compute meaningful aspect parameters for the OV1-15 satellite which was launched from Cape Kennedy, Florida, on 11 July 1968 to aid in the aspect analysis.

Input to the program consists of merged data tapes of ephemeris data and corresponding experiment data for assigned orbits.

The aspect parameters computed include the angles which display the orientation of the satellite spin axis with respect to the orbital plane of the spacecraft (as well as angles which display the attitude of the same spin axis with respect to a fixed system in space and with respect to the vehicle's velocity vector), the earth's magnetic field vector and the sun line vector. Output consists of both a listing and Calcomp plots.

TITLE:	Distribution of Alpha Particles in the Upper Atmosphere
AUTHOR:	Spuria, A.
INITIATOR:	Yates, H. (PHE)
PROJECT:	8600 PROBLEM NO. 1485
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS, 1460/Fortran IV, SPS
MINIMUM CORE SIZE:	55_8k

Several programs were written to reduce data recorded on digital tape recorders aboard flight balloons aimed at studying the distribution of alpha particles in the upper atmosphere.

Specially designed particle "telescopes" were to be sent aloft to observe particles at varying energy levels. Other instruments in the gondolas were to measure the flux of alphas which pass through a solid angle defined by the telescope and were to monitor the air pressure and temperature.

A complete program system was developed in anticipation of these flights. Dummy data was utilized to check out programs to edit, update and reformat data on magnetic tape and correct erroneous data when necessary.

TITLE: Zero Sunspot Number Fluxes
AUTHOR: Armstrong, D.

INITIATOR: Barron, W. (LIR)
PROJECT: 5629 PROBLEM NO. 1486

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 30_8k

Data for 1966 zero sunspot number fluxes contained on punched cards is reformatted for ease in plotting the values.

The flux values are available for five different frequencies.

The daily flux values are examined for features which may be useful in predicting future solar activity.

TITLE: Determination of Rocket Roll
AUTHOR: Sullivan, B.

INITIATOR: Herzberg, A. (LCR)
PROJECT: 7659 PROBLEM NO. 1487

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 25_8k

The roll rate of a spinning rocket is determined from the data of a magnetometer perpendicular to the rocket axis. The successive maximums and minimums of the spin magnetometer data are determined from sign changes in the raw data recorded in volts.

The assumption used in calculating the roll rate is that time between two consecutive maximums of the spin magnetometer is the time it takes the rocket to make one revolution. The roll rate is calculated, using the maximums and minimums as parameters.

Primary output consists of the times of maximums and minimums, the constants used to calculate the roll rate, and the roll rate. Secondary output includes the time and voltage of the minimum and the time and voltage of the maximum.

TITLE:	Rainfall Reflectivity and Attenuation
AUTHOR:	Atkinson, J.
INITIATOR:	Dyer, R. (LYW)
PROJECT:	6672 PROBLEM NO. 1488
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	40_8k

The interpretation of radar measurements of rainfall reflectivity and attenuation at different wavelengths is dependent on the raindrop size distribution assumed. Values are found by using formulas for four types of F distributions [Marshall-Palmer, Best, Levin and Litvinov] to provide some insight into exactly how critical is the choice of raindrop size, and what information concerning the distribution can be learned from measurements of received power.

TITLE:	Paper-Tape Processing
AUTHOR:	McMurray, J.
INITIATOR:	Toman, K. (LII)
PROJECT:	5631 PROBLEM NO. 1489
HARDWARE/SOFTWARE:	IBM 1012, 1460/SPS
MINIMUM CORE SIZE:	4_8k

Data recorded on paper tape is transferred to punched cards for ease in processing. The paper tape is of the following format: three-start code frames, sixteen four-word data frames and an end data frame followed by an end tape code. Since non-numeric data occurred interspersed with the data values, checks were performed to discard that data and print the alphanumeric data.

The program handles 8-track punched paper tape with control characters indicating end-of-data groups or end-of-tape status.

TITLE: Performance Results of Various Balloon Types in Flight
AUTHOR: Armstrong, D.

INITIATOR: Young, E. (LCB)
PROJECT: 6665 PROBLEM NO. 1490

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 5_8k

The performance results of various balloon types in flight are shown.

The results include weight analysis, stress analysis, and aerodynamic analysis.

The program inputs proportionality constants for the physical dimensions of Vee, Navy Class C, Ram Air C and Mark II type balloons. Several parameters describing weight, stress and aerodynamics of the flight are computed using standard physical notations. The proportionality constants were based on wind tunnel models and the scaling factors were based on actual balloon designs.

The results are output in a table suitable for publication. Several balloon flights may be analyzed during a computer run.

TITLE: Power Spectrum of Radiation - Modification of Problem No. 1357
AUTHOR: Atkinson, J.

INITIATOR: Cahill, J. (OPR)
PROJECT: 5710 PROBLEM NO. 1491

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 70_8k

Problem No. 1357, which obtains a multiplex technique (Fourier Spectroscopy) for obtaining the power spectrum of radiation, was modified.

The only change is the addition of a routine to screen the input data before it is actually read into the program, in order to eliminate incorrect data.

The data, which is supposed to be all numeric, occasionally contains incorrect alphanumeric characters. This data is checked for validity, and, if correct, it is re-read in its proper numeric format. However, if it is invalid, a message is printed, and the record is skipped.

TITLE: Contour Plots
AUTHOR: Dabcovich, M.

INITIATOR: Aiken, D. (LYD)
PROJECT: 8604 PROBLEM NO. 1492

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/ Fortran IV
MINIMUM CORE SIZE: 32_8k

A contour program accepts data in either equal or random intervals and displays a contour plotted upon a generated grid, the fineness of which is specified by the user. Isobars may be generated at equal intervals by specifying the number of contours over the entire data set or at levels determined by the user or between stated levels at a particular separation.

The grid is computed from maximum and minimum boundary values and spacing parameters supplied by the user. The contour is made relative to this equal interval data and plotted. The input points, grid values and contour values are printed as part of the output.

TITLE: Least-Squares Fit to Radioactive Decay-Type Equation
AUTHOR: Korff, H.

INITIATOR: Heroux. L. (LKO)
PROJECT: 6688 PROBLEM NO. 1493

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/ Fortran IV
MINIMUM CORE SIZE: 14_8k

The "DECAY CONSTANT" program was written to provide a least-squares fit to the expression $Y = Ae^{-\lambda_0 x} + Be^{-\lambda x} + C$, with A, B, C, λ to be fit. The observed data arose from an experiment which observes the modulations and the long-term exponential decay of metastable He^+ ions quenched in a uniform electric field. The values for λ_0 were obtained from previous experiments and from the suggestion (1) that the early part of the decay should be modulated at a frequency which is directly proportional to the Lamb shift. The main purpose of the program was to obtain values for λ to test the theory that the late part of the decay was exponential with a lifetime which is related to the Lamb shift. The linear coefficients A, B and C relate to the number of He^+ ions observed by a detector placed at varying distances from the emitted beam.

(1) G.W. Series, Phys. Rev. 136, A684 (1964).

TITLE:	C-BAND Radar Data for OV1-15, OV-16	
AUTHOR:	Chin, J.	
INITIATOR:	Hussey, I. (SUYA)	
PROJECT:	0001	PROBLEM NO. 1494
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	31_8k	

Three programs list, process and plot C-BAND beacon radar data from ETR in standard "GEOS-B" format.

"RALIST" reads in and lists all the data values of the radar data tapes.

"RVSORT" reads in from one to five input tapes, which are processed in the following manner. For each data rev. (or file) on the tape, it will identify the satellite and the station, compute the start and stop time, record the rev. no., the day of the orbit, and the station identification code. This information comprises a record for each input rev., and when all the orbits have been processed, they are sorted by the rev. no. in ascending order.

The data is formed into a master tape if none exists, or, if a master tape already exists, the new data is merged with the old data to form a new master tape.

"RADPLOT" extracts data from each record until a full orbit has been gathered and produces such plots as slant range vs time; azimuth vs elevation and altitude vs time. The program may select any time step to select data points and has the option of plotting segments of each orbit.

TITLE:	Non-Linear Lunar Libration Plots	
AUTHOR:	Dieter, K.	
INITIATOR:	Eckhardt, D. (LWG)	
PROJECT:	8654	PROBLEM NO. 1495
HARDWARE/SOFTWARE:	IBM 7094 II-7044 FCS/Fortran IV	
MINIMUM CORE SIZE:	20_8k	

The program was written to aid the investigator in the analysis of differential equations associated with lunar librations.

The stated equation is as follows:

$$y = \pm\sqrt{r^2-x^2}$$

where $r^2 = -2p \pm \sqrt{p^2-q}$

The function is calculated and plotted for different values of the parameters and for various ranges of the independent variable.

TITLE: Solution of Integral Equations
AUTHOR: Pimenidis, S.

INITIATOR: Tsipouras, P. (SUYA)
PROJECT: 0001 PROBLEM NO. 1496

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 14_8k

"CITE8" is a purely mathematical problem, which finds the roots of a given function, given the bounds of the roots, the maximum error allowed and the minimum distance between the roots.

The program points out the roots found and the function value for each root, lower and upper bounds, and minimum distance between roots. The program is written in double precision.

TITLE: OV1-15 Ion Data Reduction
AUTHOR: Fioretti, R.

INITIATOR: McIsaac, J. (LKB)
PROJECT: 6690 PROBLEM NO. 1497

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 24_8k

The purpose of the "IG115" program is the preliminary reduction and analysis of raw digital data from the ion gauge experiments flown on the OV1-15 satellite, to generate listings of pertinent output parameters, and to store this data on magnetic tape for further analysis.

The input data consists of raw digital data that has been merged with satellite ephemeris and aspect data. This data is converted by various calibration curves and equations to more meaningful parameters (such as gauge and amplifier temperatures, positive and negative ion currents, amplifier range), and stored on magnetic tape by orbit number for further processing.

TITLE:	Albedo of Natural Surfaces
AUTHOR:	Meehan, P.

INITIATOR:	Hadgigeorge, G. (LWG)	
PROJECT:	7600	PROBLEM NO. 1498

HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	25_8k

Measurements of the spectral distribution of the sky radiation and the radiation reflected by the ground were made. The solution of a double integral represents the total amount of radiation reflected from a hemisphere at a certain angle.

This program calculates values of the double integral for various values of the angle and evaluates part of the integrand called "R" in a separate subroutine. Simpson's rule is used to evaluate the double integral.

Pen-and-ink batch plots of the arrays of values for the double integrals and "R" are also output.

TITLE:	Spectroscopy Study
AUTHOR:	Russell, J.

INITIATOR:	Yoshino, K. (LKS)	
PROJECT:	8627	PROBLEM NO. 1499

HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	25_8k

Two programs fit second-degree curves to various sets of data for a spectroscopy study.

Program 1 reads a set of data points and utilizes a least-squares polynomial fit subroutine to obtain a second-degree equation for the data points.

Program 2 performs the same function, except that a shorter range of points is selected from the input observed values to be used for the curve fit.

Both programs output similar listings, consisting of (1) coefficients of the curve fitted to the points selected, (2) tabulated indexed data points, (3) value of calculated curve of those points, (4) difference between observed and calculated values, (5) difference between calculated value and constant coefficient (A), and (6) first and second differences.

TITLE: Computation of Inverse Error Function
AUTHOR: Dieter, K.

INITIATOR: Selby, J. (OPI)
PROJECT: 7670 PROBLEM NO. 1500

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 40_8k

A general-purpose routine computes the values of the inverse error function. Its purpose is to iteratively determine an unknown, X, within the function, from a known number, "VALUE."

Given a VALUE between 0 and 1, find a number X, such that

$$\text{VALUE} = \frac{2}{\sqrt{\pi}} \int_0^x e^{-t^2}\,dt.$$

The purpose of forming the general-purpose routine was that the IBM 7094 II-7044 DCS Mathematical Library has only a single precision version of the error function, and the results obtained from it were not satisfactory. Therefore, special double-precision routines were written for computing the error function.

These routines were based on rational approximations in Hart's "Computer Applications".

TITLE: Dispersion of Electromagnetic Waves
AUTHOR: Wright, B.

INITIATOR: Shickman, A. (PHD)
PROJECT: 8647 PROBLEM NO. 1501

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 3_8k

Work under this problem number concerns the creation of plots of various data associated with the dispersion of electromagnetic waves of two programs. The first program calculates the various parameters associated with the data and equations being used and produces pen-and-ink plots of the data using the magnetic tape from the first program as input. The user may specify which of the data he wishes plotted.

TITLE: Polarization Properties of Infrared Beamsplitters
AUTHOR: Dolan, J.

INITIATOR: Loewenstein, E. (OPI)
PROJECT: 7670 PROBLEM NO. 1502

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 33_8k

The energy throughput of an interferometer is calculated for the case where an unsupported thin film is used as a beamsplitter. The polarization of the beam toward the detector is calculated, and it is shown that by setting the beamsplitter at the Brewster angle rather than at the usual 45°, a completely polarized output beam can be produced with very little loss of energy.

Output consists of calcomp plots of wavenumber versus polarization (percent) and efficiency (percent) versus wavenumber.

TITLE: Least-Squares Fit
AUTHOR: Wright, B.

INITIATOR: Smiltens, J. (LQP)
PROJECT: 5620 PROBLEM NO. 1503

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 11_8k

Data points representing pressure gauge calibration data are multiplied by a constant before processing for the purpose of converting measurements from one unit to another.

The data is then input to a least-squares curve-fitting routine, and a plot of the fitted curve and a listing of the coefficients are produced.

TITLE: Sweep Radar Spectral Analysis
AUTHOR: Grossbard, N.

INITIATOR: Lammers, U. (LZN)
PROJECT: 8682 PROBLEM NO. 1504

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 123_8k

The signal received by a moving antenna from a group of source points is simulated mathematically.

Eight types of plots are output. These plots include two types of translatory antennas and the absolute value of the differences between their absolute values; vector subtraction of one translatory antenna from the other; two types of rotary antennas and the absolute value of the differences between their absolute values; and the vector subtraction of one rotary antenna from the other.

Each plot described above consists of a graph of amplitude versus frequency, a graph of $\log_{10}$ (amplitude) versus frequency, and a graph of phase versus frequency.

TITLE: Maxima and Minima of an Implicit Function
AUTHOR: Persakis, T.

INITIATOR: Tsipouras. P. (SUYA)
PROJECT: 0001 PROBLEM NO. 1505

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 40_8k

A program was needed which would determine the maxima and minima of a function V(D) over a definite interval. The program written under this problem number solves an implicit function D for the interval $0. < D < 3.X10^4$ and lists the results.

TITLE: OV1-15 Satellite Data Merge
AUTHOR: Hussey, E.

INITIATOR: Philbrick, C. (LKD)
PROJECT: 6687 PROBLEM NO. 1506

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV, MAP
MINIMUM CORE SIZE: 54_8k

This program merges telemetry and ephemeris data relating to OV1-15. The telemetry data is recorded from the satellite in packed PCM format and must be unpacked. This program unpacks the data and merges it with the ephemeris data, which is contained on a separate input tape.

In a single computer run, only orbit data can be merged.

An output listing of selected ephemeris data is also produced.

TITLE: PCM Data Unpack Subroutines
AUTHOR: Williams, D.

INITIATOR: McInerney, R. (SUYA)
PROJECT: 0001 PROBLEM NO. 1507

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 1_8k

Three subroutines exist for unpacking the OV1-15 PCM telemetry data.

(1) Subroutine "PCMRED" reads one tape record consisting of three frames (records) of data and stores them in a 156-word array. It then calls Subroutine "UNPCM," which puts the 156 words into three 52-word arrays (frames).

(2) Subroutine "PCMRED" returns one 52-word array each time it is called and reads another tape record every third time it is called.

(3) Subroutine "START" breaks down 52 60-bit words into 87 36-bit words, and returns them to the calling program.

TITLE:	OV1-16 Data and Ephemeris Merge	
AUTHOR:	Fusco, R.	
INITIATOR:	Marcos, F. (LKB)	
PROJECT:	6690	PROBLEM NO. 1508
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV, FAP	
MINIMUM CORE SIZE:	22_8k	

Ephemeris data tapes are merged with OV1-16 PCM data tapes. Input is in the form of blocked binary ephemeris tapes, unblocked OV1-16 PCM data tapes, and appropriate control cards containing orbit selection data.

A blocked, binary, merged output tape is created, and an on-line listing of eight data points taken from the raw data tape is produced.

TITLE:	OV1-16 PAM Data Merge	
AUTHOR:	Van Sorge, H.	
INITIATOR:	Marcos, F. (LKB)	
PROJECT:	6690	PROBLEM NO. 1501
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	10_8k	

Thirty-segment Phase and Amplitude Modulated (PAM) telemetry data from the OV1-16 satellite is merged with the corresponding ephemeris data.

Orbit number, file number, start and stop time are input for each orbit.

The orbit merge tape consists of a 16-word header record, 260-word data records, and one terminal record for every orbit processed. Printed are the header record, time and four interpolated values per minute (altitude, latitude, longitude and velocity), number of records processed, elapsed seconds, and start-and-stop time.

The program is capable of processing multi-orbits, but it handles only one data tape, one ephemeris tape, and one output tape. The orbital data is from real-time acquisitions.

TITLE: OV1-16 PCM Data Unpack Subroutine
AUTHOR: Fusco, R.

INITIATOR: Marcos, F. (LKO)
PROJECT: 6690 PROBLEM NO. 1510

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/FAP
MINIMUM CORE SIZE: 45_8k

OV1-16 PCM (Pulse Coded Modulation) telemetry data is unpacked from the PCM commutator of the OV1-16 satellite.

A FAP subroutine unpacks the time word and four PCM data words for each frame of data in the tape record. There are 50 frames of data in each record.

The subroutine performs the following function:

a. Maintains the count of frames in each data record operated on.

b. Extracts hours, minutes, seconds and milliseconds, and converts these to total seconds.

c. Makes out the individual PCM words in each frame, converts them to volts, and stores them in a buffer.

d. Converts all necessary words to floating point format.

e. Returns the required data to the calling program.

TITLE: Total Electron Content of the Ionosphere
AUTHOR: Conway, E.

INITIATOR: Klobuchar, J. (LIR)
PROJECT: 4643 PROBLEM NO. 1511

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 66_8k

The cross correlation between two sets of atmospheric data for each hour of the data for four two-month periods between November 1967 and June 1968 is obtained.

The data is read and stored into two arrays, a TEC (Total Electron Current) data array, and an MUF (Maximum Usable Frequency) data array. Correlations of the data and the coefficients of the best linear fit, which are used to get the standard error of estimate, are obtained.

The data points which went into computing the correlation coefficient, as well as the period number, hour, correlation coefficient, standard deviation of error, and coefficients of the best linear fit are output.

TITLE: Dead-Reckoning Flight Track - Cloud Physics
AUTHOR: Boudreau, R.

INITIATOR: Glass, M. (LYC)
PROJECT: 8620 PROBLEM NO. 1512

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 71_8k

This program was written to assist the Cloud Physics Laboratory in the determination of the location of recorded data points by graphing the flight track of an airplane while recording atmospheric data pertaining to clouds.

The flight track is calculated with respect to time by dead-reckoning, and the information is presented in the form of a map composed of several windows. A graph of each window is generated. Calcomp plots of the flight track are also produced.

TITLE: OV3-6 Vehicle Aspect
AUTHOR: Pruneau, P.

INITIATOR: Philbrick, C. (LKD)
PROJECT: 6687 PROBLEM NO. 1513

HARDWARE/SOFTWARE: IBM 7094 II-7044 CDS/Fortran IV
MINIMUM CORE SIZE: 64_8k

The "OV3-6 ASPECT" computer program was written to implement the aspect analysis to compute meaningful aspect parameters for the OV3-6 satellite.

Merged data tapes, which contain ephemeris data and the corresponding experimental data for assigned orbits, are utilized to compute the aspect parameters. These aspect parameters include the aspect (with respect to a fixed coordinate system in space) of several assigned vectors attached to the spacecraft, the angles of attack of these assigned spacecraft vectors with respect to the vehicle velocity vector, the earth's magnetic field vector and the scan-line vector.

The program generates, for assigned orbits, a listing, an 800-BPI binary tape, a 200-BPI plot tape, and several Calcomp plots of the assigned aspect parameters.

TITLE: Rapid Orbit Determination
AUTHOR: Robinson, E.

INITIATOR: Hussey, I. (SUYA)
PROJECT: 0001 PROBLEM NO. 1514

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 41_8k

The Rapid Orbit Prediction Program (ROPP) performs very rapid computation of orbital elements over many revolutions. The mean rates of change of Keplerian elements are numerically integrated to a specified time. Atmospheric draft effects and the gravitational potential of the earth are taken into consideration.

"ROPP" can predict the mean orbital elements over long intervals of time for satellite lifetime predictions. It can also be used to predict look angles for planning purposes, and eclipse times can be generated.

An eighth-order Adams Moulton integrator is used to predict the satellite parameters. Perturbations considered by the program consist of drag, luni-solar effects, earth oblateness and terms from the geopotential.

TITLE: Preparation of High-Altitude Profile Data Sets
AUTHOR: Hoffman, R.

INITIATOR: Huffman, D. (OPA)
PROJECT: 7670 PROBLEM NO. 1515

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 13_8k

High-altitude profile sets are combined mathematically with "gain" values to effect a conversion of the raw data to meaningful physical units. Further adjustment is made by subtracting a chart reading for a value of zero.

The "new" profile set (responses) is normalized, and these values, along with the degree, altitude, and the gain factor, are output. Plots of these normalized responses are also generated.

TITLE: Velocity of Wave Propagation for Fault Displacements
AUTHOR: Lonergan, F.

INITIATOR: Bliamptis, E. (LWW)
PROJECT: 7639 PROBLEM NO. 1516

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 110_8k

The velocities and displacements of three types of faulting — longitudinal shear fault, transverse shear fault and tensile fault — were evaluated and plotted as a function of time. Each type had three components—the distance of the point of observation from the fault plane (radius) and the colatitude and azimuth of this point. Three different displacement time functions—ramp time function, exponential time function and damping time function—were analyzed for each given set of parameter values for the radius, colatitude and azimuth.

TITLE: Voltage Ratio Transfer Function Analysis
AUTHOR: Persakis, T.

INITIATOR: Kriger, L. (LRS)
PROJECT: 4610 PROBLEM NO. 1517

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 56_8k

Two programs analyze the voltage ratio transfer function which is performed for various parameters to give families of response curves. This is a computer technique applied to a novel network analysis, that is, synthesizing filter characteristics with all-pass networks.

One program is concerned with an all-pass network, which is designed to introduce phase delay. Ideally, this delay should be effected with minimum attenuation at any frequency.

A network may be classified in terms of the locations of the zeroes (points where a function equals zero) and poles of the impedance or admittance function. A third-degree function results when two non-minimum phase functions are combined. This function is the minimum-phase algorithm. The transformation (as viewed from the "S" plane) consists of a shift of the pre-existing all-pass zeroes from the right-half plane.

The second program is involved with the low-pass filter. Such a filter passes (with low attenuation) all frequencies below that which is known as the cut-off frequency. Above the cut-off value, this filter produces very high attenuation.

TITLE: Molecular Wave-Functions and Energies
AUTHOR: Grossbard, N.

INITIATOR: Jasperse, J. (LQR)
PROJECT: 5621 PROBLEM NO. 1518

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 72_8k

The problem of finding the wave functions and energies for the bound-states of atoms, molecules, and ions is of central importance to the solid-state physicist who wants a quantitative understanding of the physical properties of dilute impurities in crystal lattices. New mathematical techniques for treating simple atoms, molecules and ions were studied.

Three families of integrals that arose in the three-body problem with Coulomb pair potentials were examined. Two of the families were definite integrals on a single variable where the integrands were products of two Coulomb Sturmian functions and two Legendre polynomials. Closed-form expressions were derived for all the integrals, except for one subset of the most general triple integral.

In addition, the eigenvalues and eigenvectors for a group of simultaneous linear equations were found.

TITLE: OV1-15 Data Analysis
AUTHOR: Grossbard, N.

INITIATOR: Philbrick, C. (LKD)
PROJECT: 6687 PROBLEM NO. 1519

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 41_8k

OV1-15 data was analyzed to solve for temperature and pressure by fitting angle versus pressure data readings to an experimental curve. It was necessary to isolate the portion of data to be fitted.

This is accomplished by finding the best values of temperature and pressure by minimizing a least-square error.

TITLE: Ionospheric Electromagnetic Data Processing
AUTHOR: Navisky, D.

INITIATOR: Klobuchar, J. (LIR)
PROJECT: 4643 PROBLEM NO. 1520

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 20_8k

"PLOT3" is the modified version of Problem No. 1574. Various curves of ionospheric electromagnetic data observed at night from a satellite are plotted, according to the specified options.

The electromagnetic content for each 15 minutes of the hour for the data is printed, and plots of Total Election Content versus Local Mean Time may be produced.

Over a year's data is contained on punched cards in either 5-minute or 15-minute intervals. Plots can be obtained on a daily basis by Local Mean Time or a month's data on one curve.

TITLE: Mie-Scattering
AUTHOR: Vicksell, F.

INITIATOR: Vincent, R. (PHG)
PROJECT: 8602 PROBLEM NO. 1523

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 72_8k

Emissivity and transmission spectra are found for electromagnetic radiation onto a homogeneous layer of spherical particles of uniform diameter. The required complex indices of refraction may be either tabulated and read in or computed internally. The indices may be plotted. Provision is made for the ordinary index, the extraordinary index and a computed combined index.

For each particle diameter, and for each frequency and its associated index or indices of refraction, the program evaluates several series involving the Mie scattering coefficients. The resulting scattering and extinction cross sections, the asymmetry factor, and the back-scatter are printed for each frequency, along with the corresponding emissivities and transmissions for layers of various thicknesses. The spectrum plots can be compared directly with experimental results. The model allows for a temperature gradient in the layer of particles.

TITLE: Solar Burst Data Processing
AUTHOR: Spuria, A.

INITIATOR: Barron, W. (LIR)
PROJECT: 5629 PROBLEM NO. 1524

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 17_8k

Data representing Solar Burst activity is recorded on analog tapes, which are digitized using an A-to-D converter, and the resulting packed tape is unpacked and split into 16-word records. This tape containing 16 words per record is input to this program. Calibration files are read and scaling parameters are calculated.

The pre-burst flux level is calculated, and this background is subtracted from the actual burst data. The properly scaled burst data is then calculated and written on tape in card-image form for input to a subsequent area determining program.

TITLE: Heat Flow Calculations
AUTHOR: Grossbard, N.

INITIATOR: Jasperse, J. (LQR)
PROJECT: 5620 PROBLEM NO. 1521

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 26_8k

Two programs calculate the linear flow of heat in a solid bounded by two parallel planes.

"FIGRA" computes an equation which simulates the temperature distribution of a cylinder with a constant heat production in its center and zero surface temperature. A drum plot of the temperatures within the specified region of the slab is output, with each curve in the plot representing a different time.

"FIHRA" solves the same problem as "FIGRA," except that in "FIHRA" the surface hits a zero temperature heat sink with a given heat conductivity.

TITLE: Calculation of Diffraction Patterns
AUTHOR: Persakis, T.

INITIATOR: Szabo, T. (LZM)
PROJECT: 5635 PROBLEM NO. 1522

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 15_8k

"LAG-INT" calculates diffraction patterns at various distances from a slit radiating in an anisotropic medium.

This purely mathematical problem performs parabolic (three-point) interpolation on the input data and numerical complex integration by Simpson's Rule.

An integration of the intensity profile for any desired limits (integral number of wavelengths only) is provided for determining the diffraction loss caused by an interception of the acoustic signal by a receiving transducer narrower than the acoustic beam width.

Input are cards containing variables for the number of cases, velocity in the anisotropic medium along the vertical axis, degrees, anisotropic inverse velocity at one-degree increments, slit length, and width of measuring probe.

Printed are values for the intensity, and plotted is intensity vs the distance along the horizontal axis (plane parallel to the slit).

TITLE: Balloon Flight Data Plots
AUTHOR: Guarente, J.

INITIATOR: Young, E. (LCB)
PROJECT: 6665 PROBLEM NO. 1525

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 41_8k

The problem concerns the reduction and plotting of position and attitude data from tethered balloon flights.

Two small programs plot specific information given on the input cards. The first program plots the angle of elevation, θ, versus time and the azimuth angle, ψ, versus time. The second program plots the radius, the distance along the z-axis, the angle β, the ground velocity, the tangential velocity, and the acceleration in the z-direction.

TITLE: Reduction of OV1-15 Accelerometer Data
AUTHOR: Fioretti, R.

INITIATOR: Marcos, F. (LKB)
PROJECT: 6690 PROBLEM NO. 1526

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 20_8k

Raw digital data from the Tri-axial Accelerometer equipment flown on the OV1-15 satellite was reduced. Pertinent output parameters were listed, and the data was stored on magnetic tape for further use.

The accelerometer-measured pulse rates from two sensors, channel Y and channel Z, were displayed in order to aid in preliminary data reduction and to verify the correct sensor operations.

The Y density versus the altitude (in kilometers) and the Y density versus time for selected orbits of the OV1-15 satellite were plotted, also.

TITLE:	Reduction of OV1-16 Accelerometer Data	
AUTHOR:	Fioretti, R.	
INITIATOR:	Marcos, F. (LKB)	
PROJECT:	6690	PROBLEM NO. 1527
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	32_8k	

Raw digital data from the Tri-axial Accelerometer experiment on the OV1-16 satellite is reduced and analyzed.

The input data consists of Local Time and Greenwich Meridian Time, mean anomaly, altitude above earth's surface, geodetic latitude, longitude, velocity, earth-centered range to vehicle, geocentric latitude, right ascension, velocity, geomagnetic coordinate, geomagnetic latitude and longitude, declination, inclination, velocity vectors and range time.

Listings of various output parameters, such as drag acceleration and number density, are generated, and accelerometer data versus time is plotted for each orbit processed.

In addition, the OV1-16 special accelerometer data plot program was written to plot x, y, z accelerometer output pulse rates for those special orbits (usually from the tracking station -- Carnarvon) which had forward-dubbed timing. The program was written in order to display the accelerometer pulse rates of these revs, and therefore a fictitious time word was generated in order to plot the data.

TITLE:	Electron Multiplication	
AUTHOR:	Pustaver, J.	
INITIATOR:	Newburgh, R. (LZE)	
PROJECT:	6688	PROBLEM NO. 1528
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	73_8k	

The generation of electrons within an M-stage electron multiplier is observed. The program calculates the probability of a certain number of electrons being emitted from the Kth stage when (1) one electron has struck the first stage (reference: Lombard and Martin, "Statistics of Electron Multiplication," The Review of Scientific Instruments, Vol. 32 No. 2, February 1961), and (2) two electrons have struck the first stage, (reference: Janossy, "Statistical Problems of an Electron Multiplier," Soviet Physics JETP, Vol. 1, No. 3, November 1955) for a number of values of λ, where λ is the mean number of electrons generated by the impact of a single electron.

Output consists of a plot of these values for the two cases.

TITLE: Mathematical Analysis of Three-Body Problem
AUTHOR: Lindstrom, P.

INITIATOR: Jasperse, J. (LQR)
PROJECT: 5621 PROBLEM NO. 1529

HARDWARE/SOFTWARE: Not Applicable
MINIMUM CORE SIZE: Not Applicable

The main advance in treating the quantum mechanical three-body problem has been the notion that the wavefunction, or the T-matrix, may be decomposed into a sum of three parts. The reason for making this decomposition is the hope of obtaining equations which are tractable, whereas a straightforward approach leads to many difficulties.

Once the decomposition is made, two questions immediately arise. These questions are,

a. What are the mathematical properties of the resulting equation?

b. Is the equation tractable using modern computational methods?

A study was made of some mathematical properties of an equation that describes the simplest model of neutron-deutron scattering, which still retains the basic features of a more complicated nuclear fission process.

No program decks or listings accompany this problem number, because of the fact that no computer programming was performed.

TITLE: Mesh of OGO-A Ephemeris Data Plots
AUTHOR: Rutkowski, E.

INITIATOR: Sagalyn, R. (LIF)
PROJECT: 8617 PROBLEM NO. 1530

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 62_8k

Program "MESH" was written to produce plots of ephemeris data which can be physically overlaid on data plots of the OGO-A satellite.

The program can input several plot options indicating number of plots, number of scales to be produced on each plot, type of plot, axis titles, start and stop times for specified orbits and scales for each plot.

TITLE: Satellite Observations and Element Sets
AUTHOR: Roehrig, H.

INITIATOR: Hussey, I. (SUYA)
PROJECT: 0001 PROBLEM NO. 1531

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 16_8k

Several programs were written for the purpose of designing a file maintenance system for converting data storage from punched cards to magnetic tape for satellite element sets and satellite observations.

Card images loaded on a reel of IBM 7-channel magnetic tape are edited to remove illegal punches and blanks.

Inventory is taken on a daily basis of the satellite observations which have been recorded on a magnetic tape master file.

A satellite observation file that has been stored on a reel of magnetic tape in ascending time order is searched. Information may be retrieved by satellite number, data and time, or between any combination of satellite numbers, dates and time periods.

All satellite observations for a specific satellite number are merged on one master file.

One reel of tape containing satellite observation card images which have been edited previously are stored.

A magnetic tape file is generated and contains edited satellite element sets conditioned for sorting in order by satellite number, element set number, and card number; or, if desired, by satellite number, year/day and card number.

One reel of tape containing element sets sorted in order by satellite number, element set number, and element set card number is generated.

"ELMERGE" merges two satellite element set files and produces one master file not to exceed one reel of magnetic tape. The purpose is to either create or update a satellite element set master file, defined by punched card input.

An immediate capability to retrieve 6-card element sets from an element set file is stored on magnetic tape in order by satellite number, date, element set number, and card number.

TITLE:	Station Azimuth Changes	
AUTHOR:	Persakis, T.	
INITIATOR:	Hadgigeorge, G. (LWG)	
PROJECT:	7600	PROBLEM NO. 1532
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV	
MINIMUM CORE SIZE:	123_8k	

Daily azimuth corrections, which are caused by polar motion, are determined.

Date, time and polar motion coordinates, along with the station geodetic latitude and longitude, are input, and the azimuth correction is performed by the formula,

$$\Delta P = -x \sin\lambda + y \cos\lambda\,\zeta$$

Printed output consists of the date and azimuth correction.

TITLE:	Speech Amplitude Probability and Density	
AUTHOR:	Atkinson, J.	
INITIATOR:	Griffiths, J. (LRS)	
PROJECT:	5628	PROBLEM NO. 1533
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	55_8k	

The speech amplitude probability distribution and density function for a number of speakers vocalizing selected speech material are computed. Speech samples, consisting of five minutes per talker with fifty talkers, were recorded on the PDP-1 computer.

Statistical analyses of these speech samples are generated as part of the long-range study of speech transmission devices. A frequency count histograph, a probability distribution, and a probability density function are produced.

The ultimate objectives of this research is to gain knowledge about the human speech communication process that is applicable to the solutions of immediate and long-range communication problems.

TITLE: OV1-17 Data Processing
AUTHOR: Jacobs, L.

INITIATOR: Newman, P. (LI)
PROJECT: 5710 PROBLEM NO. 1534

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV, MAP
MINIMUM CORE SIZE: 65_8k

A PCM data tape from the OV1-17 satellite is merged with an ephemeris tape. The resulting binary output tape is to be used in the data reduction analysis of the information gathered from the experimental instruments aboard the vehicle.

For each orbit processed there is a header record consisting of 18 words and a variable number of data records, consisting of 353 words and an end-of-file record.

A Lagrangian interpolation method was used to obtain ephemeris data. The ephemeris data was synchronized with the data tape information through the Greenwich Mean Time.

TITLE: Upper Atmospheric Temperature and Wind Model Tables
AUTHOR: Conway, E.

INITIATOR: Groves, G. (LKB)
PROJECT: 6690 PROBLEM NO. 1535

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 76_8k

A series of programs was written to take an initial input wind model (either north-south or east-west winds) and produce an improved model. This improved model (east-west), along with an initial temperature model, is used to calculate an improved temperature model.

The first program smooths the original north-south wind model. The east-west model was pre-smoothed. The raw north-south wind measurements are read in and stored in an array according to latitude, season, and height, and this data is smoothed. The difference between the old and new model is calculated for each month, height, and latitude. The smoothed models are printed out and punched on cards for the second program, which calculates an improved north-south wind model.

An improved version of the initial east-west wind model is produced.

Also, an improved temperature model is calculated from the initial temperature model and the converged east-west wind model. This temperature model is combined with the data from different heights and latitudes to calculate the new improved temperature model.

TITLE:	Prediction of Temperature Changes Along Aircraft Routes	
AUTHOR:	Chin, J.	
INITIATOR:	Gringorten, I. (LKI)	
PROJECT:	8624	PROBLEM NO. 1536
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS, CDC 6400/Fortran IV	
MINIMUM CORE SIZE:	100_8k	

Two programs were written to aid in the prediction of temperature changes along supersonic aircraft routes. The information obtained from the study may be used to plan aircraft routes having the fewest changes in temperature in order to save on fuel consumption, a function directly affected by temperature.

The first program sorts, preprocesses and merges basic synoptic temperature data collected at 575 stations in the northern hemisphere.

The main program utilizes the reformatted data to compute seasonal charts of 2-, 10-, 25-, 50-, 75-, 90- and 98 percentiles of temperatures. These charts are then used as the basis for finding the 10- percentile of the 24-hour increase of temperature over that temperature shown on each of the respective percentile charts. In addition, a graph is produced which gives the probability that these new temperatures 24 hours later will be equalled or exceeded at three consecutive grid points.

TITLE:	Rocket AG17.757 Aspect Calculation	
AUTHOR:	Fioretti, P.	
INITIATOR:	Ulwick, J. (LIJ)	
PROJECT:	7663	PROBLEM NO. 1537
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV	
MINIMUM CORE SIZE:	40_8k	

"RASP" is part of an operating system to calculate rocket aspect from gyroscopic data transmitted during flight. The corrected pitch and gyroscopic data from rocket number AG17.757 is input to "RASP," which calculates the azimuth, elevation, and angle of attack of the rocket aspect. Altitude and magnetic field data are calculated as a function of time and output with the angle of attack between the longitudinal axis of the rocket and the velocity and magnetic field vector.

TITLE: Synchronization and Spectrometer Data Merge And Plot
AUTHOR: Truesdale, A.

INITIATOR: Silverman, S. (LKA)
PROJECT: 7661 PROBLEM NO. 1538

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV, MAP
MINIMUM CORE SIZE: 35_8k

The synchronization and spectrometer data from Fastic-Ebert Scanning Spectrometers carried on board suborbital rocket flights is merged, listed and plotted. Each of the two types of data are contained in separate data files on digital magnetic tape. The output consists of a continuous pen-and-ink plot, a listing and a magnetic tape of the data on both input files merged into one data file by time.

TITLE: Analytical Calibration of Geodetic Stellar Cameras
AUTHOR: Almon, A.

INITIATOR: Hadgigeorge, G. (LWG)
PROJECT: 7600 PROBLEM NO. 1539

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 100_8k

Several programs perform the analytical calibration of metric camera lens systems. These programs reduce stellar position from mean place, epoch 1950, to true position at the time of observation. They reduce plate measurement, perform preliminary distortion calibration, final distortion calibration (including a solution for differential measuring bias and for star catalog error) and perform the transformation of the Gaussian symmetric radial distortion function to a balanced curve (that is, a curve with essentially equal positive and negative abscissas).

TITLE: Plot of Geographic Coordinates on a World Map
AUTHOR: Chin, J.

INITIATOR: Shea, P. (PHE)
PROJECT: 8600 PROBLEM NO. 1540

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 36_8k

A Calcomp plotter subroutine plots geographic coordinates on a world map. The plot is produced on a graph of the exact size as Calcomp Products Chart No. W2, which cannot be used because its fine mesh will reduce to a smudge when photographed.

The resulting plot on white paper is to be combined with a master, which has the outline of the major continents so that a suitable photograph or slide can be made.

The output consists of a graph, 9" x 18", containing the plotted geographic points.

TITLE: Ionospheric Height Data Interpretation
AUTHOR: Grossman, P.

INITIATOR: Rasmussen, J. (LIE)
PROJECT: 4603 PROBLEM NO. 1541

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 34_8k

Experimental ionospheric height data is converted from paper tape to cards via the 1460 utility program. The cards are transferred to disc, and printed for visual verification to insure that the data is within specified limits and that the time sequencing is correct.

The day of year, hours, minutes, seconds, meter number 1 and number 2 values, and station number, along with messages for erroneous data, are printed.

TITLE: Electrodynamic Field Study
AUTHOR: Russell, J.

INITIATOR: Thomson, K. (LWW)
PROJECT: 7639 PROBLEM NO. 1542

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 22_8k

"ELAS" investigates some of the properties of an elastic wave propagation in a semi-infinite solid medium. In particular, the program calculates the theoretical radial and tangential displacements, which are due to an impulsive force acting on a surface line of a semi-infinite medium. These results are required for further seismological investigations.

The displacements are listed versus the independent time parameter. A graph of the same results is also displayed on the systems output.

TITLE: Luminosity Profiles and Total Intensity
AUTHOR: Dieter, K.

INITIATOR: Tuan, T. (LKA)
PROJECT: 7661 PROBLEM NO. 1543

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 26_8k

Various definite integrals involving LaGuerre functions were computed, and the capabilities of earlier programs operating on LaGuerre functions were extended.

These integrals arise in the perturbation solution of the time-dependent diffusion equation, which describes the electron density profile at a given time and at a given height.

The program determines the shape of an electron density profile at any time once the initial distribution is given.

TITLE:	Analysis of Rocket Aspect Data
AUTHOR:	Stick, M.
INITIATOR:	McInerney, R. (SUYA)
PROJECT:	0001 PROBLEM NO. 1544
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	27_8k

"PLTASP" generates plots of the aspect data for selected rocket flights.

"PLTASP" plots the following:

a. Angle of attack of the notch

b. Angle of attack of the axis

c. Superimposed velocity and altitude

d. Azimuth of the axis

e. Elevation of the axis

f. Magnetic pitch angle

Each plot is with reference to time in seconds after launch and altitude in kms/sec. The program is set up to plot up to 2000 plots for each of the six types.

TITLE	OV2-5 Plasma Probe Data Reduction
AUTHOR:	Ramstrom, A.
INITIATOR:	Smiddy, M. (LIF)
PROJECT:	8611 PROBLEM NO. 1545
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	40_8k

The count data returned from the OV2-5 satellite is converted to voltage.

Positive and negative sensor tables are read from cards, and one 500-word record input from tape. The time word, the two calibrations, and the sensor data words are stored.

The data is checked to ascertain that the proper event has been located. The sensor mode is determined, and the data words are converted from counts to volts by means of the sensor tables.

The information, consisting of elapsed seconds from start of orbit and the amplifier currents (both high and low, for the positive and negative amplifiers) is output on tape and print-out.

TITLE: Analysis of Magnetic Force in the Atmosphere
AUTHOR: Atkinson, J.

INITIATOR: Chernosky, E. (LKA)
PROJECT: 7661 PROBLEM NO. 1546

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 75_8k

The purpose of this program is the analysis and statistical study of magnetic lines of force in the upper atmosphere. The study is accomplished through a series of daily, monthly, and yearly averages of the magnetic data in order to pinpoint any trends in the intensity of the force and any effect it might have on other atmospheric phenomena.

The program was designed to provide daily, monthly and annual averages of the values, and averages of the absolute differences between values, singly and in specific scopes.

These groups were the 2-3-4-6-12-24 hourly differences. For the hourly difference, the 24 hours of day 1 plus the 1st hour of the following day are used to set the 24 differences needed to be averaged. For the 2 hourly differences, the 24th hour of day 1, the 24 hours of day 2 plus the 1st hour of day 3 are used, and so on, using more hours out of days 1 and 3 as the intervals are lengthened.

The data is on tape in card image format. There are 2 card images per day with 12 hours' data on each card.

Plots of daily averages for each month as well as a plot of all monthly averages are included.

TITLE: OV2-5 List and Plot Raw Data
AUTHOR: Truesdale, A.

INITIATOR: Shuman, B. (PHG)
PROJECT: 7601 PROBLEM NO. 1547

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV, MAP
MINIMUM CORE SIZE: 32_8k

The OV2-5 data list program "ZMAGX" was written to list and plot data from preprocessed OV2-5 telemetry input tapes.

The program receives real-time data and lists and plots the calibrations and Z magnetometer for each data record. The program, (1) can process only OV2-5 tapes, (2) can process any file on the tape, (3) can plot either two of fifteen data seconds per inch.

The purpose was to provide the researcher with a means of obtaining a quick look at the Z magnetometer and calibration data from this vehicle.

TITLE:	Ionospheric Data Plots
AUTHOR:	Fusco, R.

INITIATOR:	Allen, R. (LIR)	
PROJECT:	4643	PROBLEM NO. 1548

HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	37_8k

A program was written to produce up to 48 different Calcomp plots of ionospheric data for a systems study for navigation satellites. The data specifically concerned the critical frequency at the height of the F region.

TITLE:	Seasonal Temperature Charts
AUTHOR:	Chin, J.

INITIATOR:	Gringorten, I. (LKI)	
PROJECT:	8624	PROBLEM NO. 1549

HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS; CDC 6600/Fortran IV
MINIMUM CORE SIZE:	120_8k

Seasonal temperature charts of 2, 10, 25, 50, 75, 90 and 98-percentiles of temperature and frequency distributions of 3, 6 and 12 grid-point maximums of temperature associated with each chart were obtained. Data tapes contained daily temperatures at levels of 100 mb, 50 mb, and 30 mb recorded at the times 0000Z and 1200Z for a period extending from April 1959 to December 1967. These temperatures were recorded at 1977 grid points covering the northern hemisphere from the North Pole southward to an octagon approximately at 15°N. Of these 1977 points, only 491 of these grid points that lay within the octagon were used in the computations.

TITLE: Electromagnetic Waves in a Magnetoplasma
AUTHOR: Lindstrom, P.

INITIATOR: Papa, R. (LZP)
PROJECT: 4642 PROBLEM NO. 1550

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV, MAP
MINIMUM CORE SIZE: 53_8k

This problem number was initiated to facilitate the determination of how waves propagating in a plasma will attenuate and distort. The data thus derived would be useful in the design of radio communication systems in which waves must propagate through an intervening plasma system. The calculations included, in addition to those described above, determination of the effective parameters of a hot magnetoplasma, and the normalized electrical conductivity for right-hand and left-hand circularly polarized wave.

All parameters and results were listed. A total of eight plots were created of (1) the normalized effective collision frequency divided by the constant electron neutral frequency (both right-hand and left-hand) vs the square of the normalized plasma frequency, and vs the normalized cyclotron frequency; and (2) the normalized effective plasma frequency (both right-hand and left-hand) vs the same parameters.

TITLE: Frequency Distribution of Radar Echoes
AUTHOR: Conway, E.

INITIATOR: Conover, J. (LYS)
PROJECT: 6698 PROBLEM NO. 1551

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 40_8k

The purpose of this program is to aid meteorologists in their attempts to make accurate long-range weather predictions in Southeastern Asia. Radar stations in this area take hourly readings, recording the location and intensity of any radar echoes which are present each hour. If no echoes are present, or if any mechanical difficulty is encountered, certain messages are printed.

The echoes, if present, are either circular, rectangular, or polygonal. This program is designed to produce weighted frequencies of radar echoes for variable size data samples at grid points spaced 10 nautical miles apart (up to a distance of 200 nautical miles from the station). The program is designed to omit any data not in the specified format.

The grid point values are printed out, and the average of all values a certain distance from the station is plotted.

TITLE: Statistical Study of Photocurrent vs Light Intensity Data
AUTHOR: Persakis, T.

INITIATOR: Dimond, N. (PHF)
PROJECT: 8659 PROBLEM NO. 1552

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 27_8k

A least-squares fit of photocurrent versus light intensity data is performed. Eight sets of experimental and theoretical data are plotted on CRT plots, with light intensity vs photocurrent in amps. The slope and standard deviation of errors are calculated and printed out in double precision.

TITLE: Calculation of Scattering Functions
AUTHOR: Meehan, P.

INITIATOR: Hadgigeorge, G. (LWG)
PROJECT: 7600 PROBLEM NO. 1553

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 41_8k

The program calculates the scattering functions and scattering coefficients of large particles with infinite refraction-index by the calculation of single and double integrals, some of which contain Bessel functions.

The source of information for the calculation of the Bessel functions is U.S. Department of Commerce "Handbook of Math Functions," p 370 (9.4.4 and 9.4.6).

The evaluation of the integrals is done by a modified version of the Simpson's Rule.

Pen and ink batch plots are output.

TITLE:	Reflection from an Idealized Atmospheric Wave
AUTHOR:	O'Brien, J.
INITIATOR:	Toman, K. (LII)
PROJECT:	5631 PROBLEM NO. 1554
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS; CDC 6600/Fortran IV
MINIMUM CORE SIZE:	70_8k

The behavior of the path length for a radar reflection from a perfect sinusoidal ionospheric wave is simulated. A perfect sinusoidal two-dimensional reflector was assumed to move horizontally at a constant velocity. A set of equations was derived to find specular reflection points and corresponding path lengths from the source to the reflection points and back to the receiver. In this case, the source and receiver were assumed to be coincident. Given the altitude, amplitude and length of the wave, a DCS program plots path length and rate of change of path length as a function of wave phase for the monostatic (coincident) case.

Then, two CDC programs were written as a continuation for this research project. Mathematical procedures were devised for the calculation of the specular reflection points and the corresponding path length, together with the time derivative of the path length. These procedures are utilized by the programs to compute the time variation and time derivative of the path length.

TITLE:	Upper Atmospheric Wind Phenomena
AUTHOR:	Doherty, R.
INITIATOR:	MacLeod, M. (LKC)
PROJECT:	5633 PROBLEM NO. 1555
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortrar IV
MINIMUM CORE SIZE:	23_8k

A physicist is assisted in the numerical solution of a differential equation. Discrete function values are calculated for the function solution of a first-order, linear, non-homogeneous differential equation, describing mathematically certain upper atmospheric wind phenomena.

Outpu consists of a listing containing program identification and intermediate program results, as well as the function value solutions of the differential equation.

TITLE:	Electron Density Profile	
AUTHOR:	Atkinson, J.	
INITIATOR:	Pike, C. (LIB)	
PROJECT:	5628	PROBLEM NO. 1556
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV	
MINIMUM CORE SIZE:	110_8k	

This task involved the conversion of an existing UNIVAC 1108 Fortran IV program to the CDC 6600. The program produces a realistic two-dimensional electron density profile based upon parameters which can be forecast with reasonable accuracy. The ionospheric electron density profile model consists of the sum of three Chapman layers (E, F1, F2). Electron densities in the topside ionosphere are controlled by complex motions rather than a production-loss balance and cannot be successfully described exclusively by a Chapman layer. A best fit was obtained by using the Chapman equation for the topside ionosphere, except that the electron densities are computed by using a variable scale height throughout the region.

Modifications included the options of calculating spatially varianced profiles in addition to the present time varianced profiles, plus the Calcomp plotting of these profiles.

TITLE:	OV1-15 Tri-axial Accelerometer Data Reduction	
AUTHOR:	Grossbard, N.	
INITIATOR:	Marcos, F. (LKB)	
PROJECT:	6690	PROBLEM NO. 1557
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	30_8k	

OV1-15 satellite Tri-axial Accelerometer data was reduced for the purpose of determining atmospheric density by measurement of air drag.

A typical data sample consisted of drag measurements made from 400 km down to perigee and back up to about 400 km, with a sample time of 24 minutes. Drag measurements were made at one-second intervals.

Above about 300 km, drag accelerations were negligible. A constant-frequency, constant-amplitude curve was the result of accelerations due to vehicle dynamics and instrument bias. At lower altitudes, where drag was measured, the drag accelerations, modulated at the vehicle spin frequency, were superimposed on the "drag-free" curve. The problem consisted of filtering the "drag-free" curve from the low altitude data. The result would be the drag accelerations centered about zero and modulated at the vehicle spin rate.

The Fourier response curve was checked in order to determine the atmospheric density from a numerical band pass filter of the air drag measurements.

TITLE:	Least-Squares Fit - General	
AUTHOR:	Persakis, T.	
INITIATOR:	Smiltens, J. (LQP)	
PROJECT:	5320	PROBLEM NO. 1558
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	15_8k	

The best fit of a curve was calculated by the least-squares method. The programs were tailored to specific data. Double precision was used to calculate the YY theoretical, the standard deviation and the residuals.

TITLE:	Unpack Data Tapes	
AUTHOR:	MacKinnon, J.	
INITIATOR:	Allen, R. (LIR)	
PROJECT:	5629	PROBLEM NO. 1559
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/MAP	
MINIMUM CORE SIZE:	21_8k	

The MAP subroutine unpacks data tapes digitized at Hamilton, Massachusetts, on a PDP-9 computer so that they can be used on the DCS. Variable-length 9-bit word frames can be unpacked. The data is unpacked in a 1000-word array in integer form. Beginning record time and TCT (Time Code Translator) time are converted to integer form and unpacked in four words as days, hours, minutes and seconds.

TITLE: Solution of Differential Wave Equations
AUTHOR: Wright, B.

INITIATOR: Horowitz, S. (LII)
PROJECT: 5631 PROBLEM NO. 1560

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 75_8k

Differential wave equations governing radio propagation in the ionosphere are solved. The method involves two solutions which correspond to waves incident onto the ionosphere from below, with polarizations chosen to give the greatest and the least penetration at great heights.

The program is designed to handle four distinct types of problems, which are described below:

a. Nighttime propagation at frequencies below the gyro-frequency, under conditions conducive to transition to the whistler mode.

b. Daytime or equatorial propagation at frequencies above the gyrofrequency but without F-layer penetration.

c. Propagation of the downgoing whistler wave.

c. F-layer penetration by up-going waves.

TITLE: Tracking of Meteor Trails
AUTHOR: Atkinson, J.

INITIATOR: Pazniokas, J. (LYU)
PROJECT: 8628 PROBLEM NO. 1561

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 56_8k

Data, collected from radar stations and punched onto cards, consisted of the range to the trail (the perpendicular distance to the meteor from the station), and the elevation (the angle made by the range line and the coordinate system defined at the tracking station). Plots of range versus elevation were generated from this data.

TITLE: Cloud Data from Nimbus II Satellite
AUTHOR: Atkinson, J.

INITIATOR: Conover, J. (LYS)
PROJECT: 6698 PROBLEM NO. 1562

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 21_8k

Cloud data is gathered over a period of days from June to August 1967, by a Nimbus II satellite. The average cloudiness for certain groups of days is computed and listed in response to a Tertile 1 or a Tertile 3 day for four different stations, Tan Son Nhut, Plaiku, Ubon, and Udorn.

The program is limited as to the amount of data it can handle at one time. To compensate for this restriction, a separate disk unit is required for each month used in the analysis.

TITLE: Time-Dependent Equation of Motion
AUTHOR: Pustaver, J.

INITIATOR: Rush, C. (LII)
PROJECT: 5621 PROBLEM NO. 1563

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 37_8k

The program obtains solutions for the time-dependent equation of motion for the neutral atmosphere, taking into account the effects of the ionized atmosphere. The equation of motion is actually two coupled partial differential equations relating the horizontal wind velocities in the north-south and east-west directions to the pressure gradients resulting from the diurnal variation of the atmospheric density.

For a given time increment, a system of linear equations is solved by the Gauss-Seidel iterative technique. An eight-point difference scheme is used as a predictor and the six-point Crank-Nicolson scheme is used as a corrector. Although the problem is solved for time increments of ten minutes, the results are output for 60-minute time increments. Also output is plot data on the CRT.

TITLE:	Complex Eigenvalues and Eigenvectors
AUTHOR:	Dieter, K.
INITIATOR:	Tsipouras, P. (SUYA)
PROJECT:	0001 PROBLEM NO. 1564
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	25_8k

The eigenvalues, λ, (characteristic values) of an arbitrary complex matrix and the eigenvectors of a complex Hermitian matrix were calculated.

TITLE:	Analysis of Radar Doppler Data
AUTHOR:	Grossbard, N.
INITIATOR:	Sweeney, H. (LYW)
PROJECT:	6672 PROBLEM NO. 1565
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS; CDC 6600/Fortran IV
MINIMUM CORE SIZE	131_8k

Radar Doppler data was reduced. The data on a tape provided by the initiator was unblocked and placed on an output tape in logical records of 8192 words.

A Fourier analysis of this data was performed and the mean, variance and an estimate of power over a restricted portion of the transformed data were computed.

The Fourier series associated with the data groups were then found and placed on magnetic tape. These Fourier series were also plotted on a drum plotter and on an off-line CRT plot.

TITLE:	Frequency Distribution of Atmospheric Data
AUTHOR:	Mazzio, V.
INITIATOR:	Wyngaard, J. (LYB)
PROJECT:	7655 PROBLEM NO. 1566
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	73_8k

A tape data analysis is performed on the frequency distribution of converted A/D data gathered in a fluid dynamics study.

Function values, consisting of horizontal wind velocity and air temperature, are analyzed at various points in space to find the mean wind and mean temperature as well as the correlations between the deviations from the mean at the different points in space.

Output consists of the mean wind and temperature, the correlation between wind fluctuation in the wind direction, the lateral wind correlation and temperature correlation.

TITLE:	Spectroscopic Data Processing
AUTHOR:	Mandell, C.
INITIATOR:	McClatchey, R. (OPI)
PROJECT:	7670 PROBLEM NO. 1567
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	40_8k

Several programs convert card data into a standard format, create a master tape, and accomplish insertion, deletion and replacement of the data on this master tape. The ultimate objective of this organization is to compute, for any atmospheric condition, the transmission of radiation through the visible to microwave region of the atmosphere.

The input cards contain generated spectroscopic data on molecular absorption and emission for all molecules that absorb radiation in a normal atmosphere (that is, "normal" as opposed to a polluted atmosphere). The data on the master tape is organized according to ascending frequencies.

Standard card data input can be inserted from cards or tape into this master tape. Also, data between any two frequencies can be deleted according to type of molecule; or type and isotope; or type, isotope and quantum numbers.

TITLE: Vehicle Attitude Correction
AUTHOR: Greco, F.

INITIATOR: Sherman, C. (LKD)
PROJECT: 6687 PROBLEM NO. 1568

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 30_8k

Data concerning air composition as a function of altitude was collected by a rocket-borne mass spectrometer and was contained on cards as voltage vs flight time. From this atmospheric data sampling, a vehicle attitude correction factor was calculated.

TITLE: Processing of OGO-A Plasma Probe Data
AUTHOR: Rutkowski, E.

INITIATOR: Sagalyn, R. (LIF)
PROJECT: 8617 PROBLEM NO. 1569

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 12_8k

Mode 1 data from Experiment 12 on the OGO-A satellite is processed and plotted. All valid reduced data is plotted and output on tape.

Two types of plots, either a drum or a CRT plot of flux versus universal time, may be output. Also, digital output consisting of universal time and corresponding flux and energy level may be produced on a specified unit.

TITLE:	Dispersion Relation for Magnetic Surface Waves
AUTHOR:	Dieter, K.
INITIATOR:	Sethares, J. (LRA)
PROJECT:	5635 PROBLEM NO. 1570
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	10_8k

A system of equations defined by a 3-by-3 determinant was solved. The equations resulted from a previous solution of the magnetization equation, coupled with Maxwell's equations, to which a set of boundary conditions had been applied. The expression was solved first for given parameter values and subsequently (in double precision) the roots of a sixth degree polynomial, which was derived algebraically from the determinant, were also found.

Plots of the resulting data were produced so that an overall view of the calculations could be made.

TITLE:	Test Bed Satellite Study
AUTHOR:	Roehrig, H.
INITIATOR:	Cronin, E.C. (SUYA)
PROJECT:	0001 PROBLEM NO. 1571
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	41_8k

The purpose of this effort is to prepare radar observational data, retrieved from the Analysis and Simulation Branch Orbital Archives, in a selective manner for utilization in support of specific AFCRL scientific research efforts.

Unclassified satellite observation data stored on magnetic tape in card-image format is edited and cards containing illegal characters are eliminated from the output tape.

On first sort the resulting data file is ordered by Date, Time and Satellite Number. This data file is inventoried on a daily basis. The daily totals and corresponding dates are printed out in columnar form. The total number of observations and total number of days in the data file are printed as the title of the inventory.

On second sort the resulting data file is ordered by Satellite Number, Date and Time. The total number of observations is inventoried by Satellite Number on a daily basis. The Satellite Number and total number of observations are printed in the heading of the inventory. The daily totals and corresponding data are printed in columnar form.

Data from these history files may be retrieved by date, time and satellite vehicle number.

TITLE:	Analysis of Data from a Low-Orbit Satellite
AUTHOR:	Conway, E.
INITIATOR:	Klobuchar, J. (LIR)
PROJECT:	4643 PROBLEM NO. 1572
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	55_8k

The program "KORBIT" was written to analyze the total electron current vs time, latitude and magnetic K index.

The primary interest was in total electron current vs magnetic K index for various seasons, times, and latitudes. The data was obtained from approximately 1000 revolutions of a low orbit satellite, and then was stored on tape.

The output consists of values of percent differences. Each percent value is followed by the number of measurements which went into determining this value.

TITLE:	Total Electron Content Data Handling
AUTHOR:	Armstrong, D.
INITIATOR:	Klobuchar, J. (LIR)
PROJECT:	4643 PROBLEM NO. 1573
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	76_8k

A box of binary card decks is transferred to a magnetic tape to be used on the DCS in order to reduce the size of the source deck for ease in input handling.

The data consists of satellite information. Output consists of a listing of station numbers, names, and their geodetic latitude and longitude. Tables of satellite information, such as date, time, zenith angle, azimuth angle, and range in km., are produced.

In addition, plots of total electron content vs latitude in degrees are output.

TITLE: Ionospheric Electromagnetic Data Plot
AUTHOR: Dolan, J.

INITIATOR: Klobuchar, J. (LIR)
PROJECT: 4643 PROBLEM NO. 1574

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 33_8k

Various curves of ionospheric electromagnetic data observed at night from a satellite may be plotted by this program.

Over a year's data recorded at five-minute intervals of fifteen-minute intervals is contained on punched cards.

The electromagnetic content for each fifteen minutes of the hour of the data is printed, and plots of Total Electron Content versus Local Mean Time may be produced.

TITLE: Large Matrix Inversion/General Purpose
AUTHOR: Dieter, K.

INITIATOR: Tsipouras, P. (SUYA)
PROJECT: 0001 PROBLEM NO. 1575

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 20_8k

A general-purpose subroutine was needed to invert large general matrices which cannot be accommodated within the core storage areas of most computers.

"INVERT" was written to satisfy this requirement. This subroutine can be applied to any program where matrix inversion is needed.

The program reads in a specified number of rows of a general matrix of a certain order. These rows are then processed and stored temporarily on disk or tape until all rows within the matrix have been processed.

The inverted matrix stored on disk or tape may now be descaled row by row and written out, or may be used as it stands.

TITLE:	Analysis of Optical Measurements from Balloon Flight
AUTHOR:	Atkinson, J.
INITIATOR:	Toolin, R. (OPA)
PROJECT:	7621 PROBLEM NO. 1576
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	26_8k

The purpose of this project was to obtain sun-oriented atmospheric optics measurements using the high-altitude balloon. The experimental package was configured to measure the spectral intensity and polarization of optical radiation emerging through the atmosphere and also to determine the infrared absorptions by water vapor in the atmosphere.

Five to seven hours of telemetered data, both optical and "house-keeping" types, were presented and then interpreted in terms of the primary sensors which produced the transduced signals.

The pulse measurements are plotted in terms of voltage versus time to give a visual representation of the actual launch.

TITLE:	Atmospheric Optical Attenuation Model
AUTHOR:	Hoffman, R. and DeSantis, L.
INITIATOR:	McClatchey, R. (OPI)
PROJECT:	7670 PROBLEM NO. 1577
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	10_8k

Optical attenuation coefficients and optical thicknesses were calculated. These values were determined as functions of both wavelength and altitude for a model of a clear standard stmosphere in the ultraviolet, visible and infrared regions of the spectrum.

For each wavelength, a page was printed, listing the coefficients and optical thickness, along with other pertinent data for the Rayleigh, aerosol and ozone components and for extinction.

TITLE: Digital Infrasonic Data Reduction
AUTHOR: Grossman, P.; Dabcovich, M.

INITIATOR: Iliff, E. (LWW)
PROJECT: 7637 PROBLEM NO. 1578

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS; IBM 1401/Fortran IV; SPS
MINIMUM CORE SIZE: 100_8k

Digital infrasonic data was adjusted for changes in gain and zero level, and any data which exceeded a specified threshold was modified. The adjusted data was listed, plotted and placed on punched cards.

Data from longitudinally punched paper tape was transferred to magnetic tape, converted to the original numbers and checked for parity errors. The data was then sorted according to original paper tape track and punched onto cards.

TITLE: Editing and Analysis of Meteorological Reports
AUTHOR: Armstrong, D.

INITIATOR: Conover, J. (LYS)
PROJECT: 6698 PROBLEM NO. 1579

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 14_8k

Various items are extracted from a tape containing meteorological information. A listing of the information is produced, and also output is a new tape containing only the extracted information.

The data extracted and listed consists of the time of report, the latitude, the longitude, the wind direction and the wind velocity.

TITLE:	OV1-15 Data Emission Regulator Curve Fit	
AUTHOR:	Noble, H.	
INITIATOR:	Philbrick, C. (LKD)	
PROJECT:	6687	PROBLEM NO. 1580
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	56_8k	

Experimental measurements of the Ion Mass Spectrometer on the OV1-15 satellite are corrected.

The emission regulator readings contained on tape recorded on the satellite are processed. The data is accumulated for an entire orbit, and an exponential curve is fit to the data. An equation is developed as a function of altitude to correct the measurements in other programs.

Output consists of the altitudes and corresponding emission regulator values, along with listings of the coefficients of the equations, the estimate of the error in the curve fit, and the values used in computing the coefficients. Plots of the computed curves and raw data are generated, as well.

TITLE:	OV1-15 Mode Determination Program	
AUTHOR:	Desrochers, R.	
INITIATOR:	Philbrick, C. (LKD)	
PROJECT:	6687	PROBLEM NO. 1581
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV, FAP	
MINIMUM CORE SIZE:	75_8k	

The Mode Determination Program was written to provide a pair of tapes containing Ion Mass Spectrometer experimental data. The Mass Spectrometer I and II experimental data from OV1-15 is identified, coded and formatted.

The input to the program consists of a tape with ephemeris, aspect and experimental data as well as control cards, tables, etc., used in reducing the data. The input experimental data is in the form of counts, and is converted into volts prior to any processing of the data. The spectra volts are, in turn, converted to current form (amps).

The reduction process results in the output data being segregated and identified by mode, each record consisting of all the data for one mode cycle. Modes 1 through 4 are written on one tape. Mode 5 (scan data) is written on a separate tape. The program also produces an indicative listing of each output record.

Multiple or selected files can be processed.

TITLE: MS I Current vs Altitude Plot for OV1-15
AUTHOR: Desrochers, R.

INITIATOR: Philbrick, C. (LKD)
PROJECT: 6687 PROBLEM NO. 1582

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 75_8k

The purpose of this program is to process the Mass Spectrometer I Neutral Set-mode Data from the OV1-15 vehicle. This data is on a tape created by a mode determination program and has been identified by mode. The ephemeris, aspect and spectra data (in amps), for one mode make up a logical record. During the time interval (12 seconds approx.) for one mode, there are normally one or two points where the attack angle reaches a minimum value. This program locates those points, searches for a peak value in the data corresponding to this point in time, and stores all of the associated ephemeris and aspect information required to plot the peak values.

If the attack angles at RAM point are greater than zero degrees, a cosine correction is applied to the peak values. When all of the data has been processed, a listing and a plot is produced.

TITLE: MS I Spin Cycle Plot for OV1-15
AUTHOR: Dalton, L.

INITIATOR: Philbrick, C. (LKD)
PROJECT: 6687 PROBLEM NO. 1583

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 17_8k

Spin cycles from the MS I experiment on the OV1-15 vehicle are plotted. The current, both corrected and uncorrected by the Emission Regulator Monitor pin, is plotted versus Greenwich Meridian Time. Any spin cycle selected by altitude can be plotted.

The header record for the orbit is listed, along with the identifying mode for the data being plotted. The GMT, longitude, latitude, and altitude are also listed.

TITLE: MS II Ion Plot for OV1-15
AUTHOR: Williams, D.

INITIATOR: Philbrick, C. (PHD)
PROJECT: 6687 PROBLEM NO. 1584

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 72_8k

Mass Spectrometer II ion data from the OV1-15 satellite is plotted. Masses N, O, N_2 and O_2 are plotted with current (10^{-12} to 10^{-7} amperes) versus altitude (100-km increments) and latitude (50-km increments).

A list is printed of altitude, latitude, angle and current value of each ram point. An optional binary tape containing ram points, current and other values for one or more orbits may also be output.

TITLE: Temperature Determination (OV1-15)
AUTHOR: Grossbard, N.

INITIATOR: Philbrick, C. (LKD)
PROJECT: 6687 PROBLEM NO. 1585

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 41_8K

Temperature and pressure are determined from the slope of mass for the OV1-15 satellite. Angle versus pressure data readings are fit to an experimental curve.

It was necessary to isolate the portion of the data to be fitted.

TITLE: INJUN V Tape Unpack
AUTHOR: Sarris, G.

INITIATOR: Sagalyn, R. (LIF)
PROJECT: 8617 PROBLEM NO. 1586

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 50_8k

Raw voltages (from TM-1, TM-2, and TM-3 sensors) from the INJUN V satellite are printed and plotted, with a time interval of seven minutes of elapsed time per CRT frame. Breaks in an otherwise continuous line plot are indicative of time jumps of varying magnitudes.

Subsequent expansion has provided a more comprehensive program which accumulates specific data at certain time intervals. This data, consisting of (1) time jumps, (2) orbital change information, (3) calibrates, and (4) log system information, is displayed at the completion of each printout.

TITLE:	INJUN V Plasma Probe Mode 1	
AUTHOR:	Carbone, J.	
INITIATOR:	Sagalyn, R. (LIF)	
PROJECT:	8617	PROBLEM NO. 1587
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV	
MINIMUM CORE SIZE:	70_8k	

High-bit rate (HBR) data from the AD/I-C INJUN V spacecraft launched 8 August 1968 was processed.

The spherical electrostatic analyzer experiment was designed to measure the flux, density, energy distribution and temperature of positively and negatively charged particles in the energy range 0 to 2 kev. This particular effort concerns data processing for Mode 1 of the INJUN V Plasma Probe.

The data input on magnetic tape was separated into two categories, Mode A and Mode B. Within each mode, eight phases were recognized. Each of these phases was processed in a manner suitable to the type of data it contained. Plots of electron or proton density versus time were produced. Using these plots, the researcher can investigate periods of activity which are of interest to him.

TITLE:	INJUN V Plasma Probe Mode 2	
AUTHOR:	Carbone, J.	
INITIATOR:	Sagalyn, R. (LIF)	
PROJECT:	8617	PROBLEM NO. 1588
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV	
MINIMUM CORE SIZE:	70_8k	

This project was concerned with the reduction of high-bit rate data from the AD/I-C INJUN V Satellite launched 8 August 1968. In particular, data processing for Mode 2 of the INJUN V Plasma Probe was performed.

The purpose of the spherical electrostatic analyzer experiment was to measure the density, flux, energy distribution and temperature of positively and negatively charged particles in the energy range 0 to 2 kev.

The input data was separated into two categories, Mode A and Mode B. Within each of these categories, there were eight phases, which were processed in a manner suitable to the type of data they contained. Plots of electron current versus applied grid voltage were produced. The researcher can use these plots to investigate periods of activity which are of interest to him.

TITLE:	INJUN V Plasma Probe Mode 3
AUTHOR:	Carbone, J.
INITIATOR:	Sagalyn, R. (LIF)
PROJECT:	8617 PROBLEM NO. 1589
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	70_8k

High-bit rate data from the INJUN V Satellite was processed for Mode 3 of the INJUN V Plasma Probe.

The spherical electrostatic analyzer experiment was undertaken to measure the density, flux, energy distribution and temperature of positively and negatively charged particles in the energy range 0 to 2 kev.

The input data was separated into two categories, Mode A and Mode B. Within each of these categories, there were eight phases, which were processed in a manner suitable to the type of data they contained. Plots of positive ion current versus applied collector voltage were produced. These plots are useful in investigating periods of activity interesting to him.

TITLE:	Monte Carlo Calculations of Electron Transport - Conversion
AUTHOR:	Crossman, P.
INITIATOR:	Garth, J. (LQR)
PROJECT:	5620 PROBLEM NO. 1590
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	41_8k

A program which yields simulated data on the penetrating of electrons into a semi-infinite slab by means of a Monte Carlo scheme is converted from the IBM 360 to the DCS.

The Monte Carlo approach consists of the calculation of trajectories in the absorber for a large number of incident electrons, simulating the encounters between these particles and the electrons and the nuclei of the medium.

The output consists of the transmission, absorption and albedo for the entire absorber and any of the following optional items tabulated at a sequence of pre-selected depths:

a. Transmission factor and dose
b. Energy/angle histograms
c. Intensity of bremsstrahlung

TITLE: Absorption Through a Chapman Layer
AUTHOR: DeSantis, L.

INITIATOR: Sales, G. (LII)
PROJECT: 5631 PROBLEM NO. 1591

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 44_8k

The frequency and zenith angle dependence of absorption through a Chapman's Layer is determined.

Tabular values and plots are generated. There are two forms of tabular values generated as follows:

a. G, C(G), S(G), I(G), and F(G). G is used for incrementing. C(G) and S(G) are generated by a Fresnal integral routine. F(G) is the absorption function, and I(G) is a function of F(G).

b. K, G, and B(G). BK(G) is the absorption ratio. K is a coefficient in a mathematical equation.

Output also are plots of I(G) vs G, F(G) vs G, and B_K(G) vs G, which is a family of 50 curves.

TITLE: Telemetry Data Processing for OGO Satellite
AUTHOR: Wright, W.

INITIATOR: Bedo, D. (LKO)
PROJECT: 5631 PROBLEM NO. 1592

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 50_8k

Telemetry data returned by the OGO-D satellite is unpacked from the original digital tapes and processed for later use. This problem is a first step in an experiment measuring photons as a function of varying collimator scan positions.

This experiment uses a scanning, plane grating spectrometer to measure solar radiation intensities in the 170 Å to 1700 Å region. When in the operating mode, the experiment can scan repeatedly the above spectral region in 7.373 minutes. For examining short-term intensity variations, the experiment can be commanded to execute short scans, which are uniformly distributed over the angular range of the full scan. There are 31 possible sub-scans requiring 37 steps and .533 minutes each.

TITLE:	Calculation of Model Densities	
AUTHOR:	Dieter, K.	
INITIATOR:	Schweinfurth, R. (LKB)	
PROJECT:	6690	PROBLEM NO. 1593
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	70_8k	

This program was written to aid in the study of the relationships among geomagnetic index, solar flux, and the ratio of certain statistical quantities as a function of time. The observational data is compared with a model developed from theoretical considerations. The computer plot output helps to display the degree of correlation between theory and experiment.

Given a certain atmospheric temperature and certain altitude, the program interpolates both vertically and horizontally to find the corresponding density.

TITLE:	Electron Excitation Functions	
AUTHOR:	Russell, Jr.	
INITIATOR:	Cohen, M. (LKO)	
PROJECT:	6688	PROBLEM NO. 1594
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV	
MINIMUM CORE SIZE:	20_8k	

This problem is concerned with the calculation of electron excitation functions. The basic problem is the evaluation of the integral,

$$S = \int_{v_1}^{\infty} vF(v)Q(v)dv$$

where "V" represents the velocity of an electron, F(v) is the tneoretical Maxwell Boltzmann distribution of speeds of the electron population, and Q(v) is the cross-section (or probability) of a particular reaction taking place.

Approximately thirty curves of Q(v) vs v, representing transitions of various designated ions, were supplied by the initiator and digitized for computer processing. The lower limit, v_1, of the integral is the velocity value at which the transition becomes energetically possible.

TITLE: Roots of Associated Legendre Polynomials
AUTHOR: Russell, J.

INITIATOR: White, M. (PHD)
PROJECT: 8647 PROBLEM NO. 1595

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 20_8k

The program "ASSOC-RTS" was written to calculate the roots of the "associated Legendre polynomials" up to and including degree 15. These roots are required in the study of the origin of the stars and planets.

The program generates a listing displaying the upper and lower bound of the roots, the minimum distance between roots, the roots in terms of the cosine, and the roots in terms of the complement of the cosine. That is, since the roots are between zero and one, the root is expressed in terms of the cosine or its complement.

TITLE: Analysis of Pressure-Height Data - Monsoon Study
AUTHOR: Mandell, C.

INITIATOR: Conover, J. (LYS)
PROJECT: 6698 PROBLEM NO. 1596

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 50_8k

This series of programs was developed for the meteorology department for the analysis of large-scale pressure-height data, and with other associated computer products has been used in a paper titled "Summer Monsoon Studies of Clouds and Weather over SEA, Utilizing Satellite Data." This data is geopotential sea level, height observations which were taken over most of Asia and the Western Pacific Ocean during the months of June, July and August of 1967 and 1968. The average geopotential or pressure heights and atmospheric height thicknesses were ultimately desired for correlation with precipitation patterns resulting from radar readings in an attempt to understand variations in monsoon activity in that part of the world.

Sea level pressure observations were used to verify a simple method of predicting the radar index, RI values used in an effort to determine large-scale synoptic events preceding activity or inactivity, as in the case of the pressure-height analysis.

The programs in this problem number perform calculations consisting of pressure-height averages, pressure-height thicknesses, and correlations of the above with the radar indexes for various stations in Southeast Asia.

TITLE:	Back-Scattered Field of a Cylinder
AUTHOR:	Whelan, L.
INITIATOR:	Holt, F. (LZE)
PROJECT:	5635 PROBLEM NO. 1597
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	16_8k

A set of complex coefficients and their phase angles and amplitudes are computed and tabulated in a theoretically derived formula for the back-scattered field which results when a planar EM wave is incident to a perfectly conducting cylinder at angles between 0 and 90 degrees.

Three different values of a parameter relating cylinder dimensions and incident EM wavelengths were chosen, and the set of coefficients was computed for each.

Also, the coefficients for some special values of the parameter were computed in order to compare the theoretical coefficient values with available experimental data.

TITLE:	Dispersion of Electromagnetic Waves in a Plasma
AUTHOR:	Meehan, P.
INITIATOR:	Dubs, C. (PHD)
PROJECT:	8647 PROBLEM NO. 1598
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	20_8k

Several variables were calculated in a study concerning dispersion of electromagnetic waves in a plasma with magnetic field. The program can handle several different models including, Lorentz, Lorentz and Coulomb, Full Theory and Sen-Wyler. The original program written under Problem Number 1501 was changed so that very large values would be reduced to improve on accuracy.

A portion of the program was modified to allow for the added capability of solving a crossover suppression problem.

The program has the option of a printed output or plot or both.

TITLE: Characterization of Photodetectors
AUTHOR: Chin, J.

INITIATOR: Van Tassel, R. (LKS)
PROJECT: 8627 PROBLEM NO. 1599

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 26_8k

A study to determine the optimum conditions of photodetectors is being conducted through an observance of statistical noise in data acquisition.

The apparatus consists of a pulsed DC Light Source operating at 5000 Hz, a monochromator to select a portion of the radiation at a specific wavelength, a photomultiplier to detect the radiation passed by the monochromator, and an electrometer (spectrometer) to measure the output current of the photomultiplier. A strip-chart recorder is used to record the electrometer output, which is transferred onto magnetic tape by means of a shaft encoder on the stripchart recorder. The encoder acts as an Analog-to-Digital converter and as a magnetic tape recorder.

The experiment consists of measuring and recording the electrometer output for varying conditions. The variables which may be changed include the light intensity, the photomultiplier gain, the electrometer time constant, and the sampling rate. The objective of the study is to determine the optimum operating conditions (that is, to co-minimize the standard deviation and the time required to obtain data).

The spectrometer output, which is recorded as sets of numbers on magnetic tape, is being used to characterize several photodetectors. A program was written to compute the means and standard deviations of these sets of numbers and the results are used to compare actual photodetector characteristics with theoretical models. This method has made it possible to determine the optimum running condition of the spectrometer as well as the optimum high voltage on the photomultiplier itself. A detailed analysis of this data has demonstrated a surprising departure from the short noise, which is usually dominant in photomultiplier detectors. At high voltage levels, a significant noise component is linearly proportional to the signal (in contrast with that noise which is linearly proportional to the square root of the signal). Changes in the procedure and instrumentation are being made to optimize the instrumental running time on the basis of the computer results.

TITLE:	Analysis of Photon Data	
AUTHOR:	Van Sorge, H.	
INITIATOR:	Higgins, J. (LKO)	
PROJECT:	6688	PROBLEM NO. 1600
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV	
MINIMUM CORE SIZE:	45_8k	

Six programs were needed to analyze counts of photons in the ultraviolet spectrum. Analysis consists of reduction, conversion and plotting of the data recorded on tapes in analog form from a rocket-borne spectrometer.

The actual manipulation of data consists of seven steps, as follows:

a. Plot the raw data file.

b. Reduce and plot calibration data.

c. Plot count-rate data vs time and vs wavelength.

d. Locate scale shifts between apogee scans and other scans.

e. Find wavelength curve for a plot of the flux curve.

f. Convert photon count to flux and plot count vs wavelength.

g. Integrate count-rate and flux curves.

TITLE:	Orthogonalization of a set of N Linearly Independent Vectors	
AUTHOR:	Martine, J.	
INITIATOR:	Tsipouras, P. (SUYA)	
PROJECT:	0001	PROBLEM NO. 1601
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV	
MINIMUM CORE SIZE:	41_8k	

This problem was initiated to produce a program which would determine an orthonormal basis of a vector space. In this program, the Gram-Schmidt Orthoganalization Process is used to find the basis of an "N" dimensional vector space given "N" linearly independent vectors.

Two programs, a single-precision version and a double-precision version, were produced. Output consists of the later basis, the calculated orthonormal basis, and the values of the dot products of the orthonormal basis.

TITLE: Piezoelectric Force Transducer
AUTHOR: Russell, J.

INITIATOR: Kuenzler, H. (LWW)
PROJECT: 7639 PROBLEM NO. 1602

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 76_8k

A program was necessary which would calculate a frequency response function by solving a complex system of linear equations which describe the electronics of a piezoelectric crystal system. The linear equations are the results of previous tests and calculations in which a Fourier transform was employed to determine the time function which produced a frequency response function of a piezoelectric crystal. These functions are necessary in the study of seismic waveforms.

TITLE: Sagamore Hill Radio Observatory Edit System
AUTHOR: Arsenault, R.

INITIATOR: Aarons, J. (LIR)
PROJECT: 4643 PROBLEM NO. 1603

HARDWARE/SOFTWARE: PDP-9/MACRO-9
MINIMUM CORE SIZE: 16_8k

A series of subroutines was written as part of the Sagamore Hill Edit System (EDSYS) effort.

At the four installations at the AFCRL Radio Astronomy Branch Radio Observatory, Sagamore Hill, many different experiments and observations are conducted. The variety of data that is produced must be digitized before processing on a digital computer. At Sagamore Hill, a Digital Equipment Corporation (DEC) PDP-9 data processing system is used to digitize the analog data into a standard digital tape format, which greatly reduces the effort required to implement follow-on data processing and analysis.

The programs described here allow the user several means by which he may further prepare his data. These programs read, restructure, and display the data on a cathode ray tube (CRT) display.

There are twenty-eight (28) routines that can be used to read data tapes, select and display segments of data and manipulate the data through the use of a cathode ray tube display unit and a light pen.

TITLE: Digital Filtering of Rocket Data
AUTHOR: Grossbard, N.

INITIATOR: Silverman, S. (LKA)
PROJECT: 7661 PROBLEM NO. 1604

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 67_8k

Rocket data provided by the initiator is filtered numerically. Periods below a certain point are left alone, and periods above another point are filtered out.

The input data and the filtered results are printed and plotted on the CRT in groups of 200 points.

TITLE: Proton and Electron Telemetry Data Reduction
AUTHOR: MacKinnon, J.

INITIATOR: Vancour, R. (PHG)
PROJECT: 7601 PROBLEM NO. 1605

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 17_8k

"Rocket-2" processes digitized measurements of electrons and protons from telemetry data tapes obtained from rocket flights. The program has the capacity to examine almost an unlimited amount of continuous data measurements and reduce the measurements to meaningful electron and proton counts associated with time periods at which the measurements were taken.

Input parameters specifying record size, channels to be processed, mode time limits, threshold limits, off-line listings, number of tapes to process, etc., are read from cards.

Four types of output are produced: (1) A summary listing of counts of events per recording mode time, (2) a magnetic tape of the beginning times of each electron or proton event by channel, by recording mode period, (3) optional listing of beginning event times as described in (2) above, and (4) optional printout of each data record read.

TITLE: Numerical Calculation of Vertical Cutoff Rigidity Derivatives
AUTHOR: Pustaver, J.

INITIATOR: Smart, D. (PHE)
PROJECT: 8600 PROBLEM NO. 1606

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 56_8k

Cosmic radiation can be measured by the position of the cosmic-ray equator which is defined either as a maximum in vertical cutoff rigidity or as a minimum in the cosmic-ray counting rate as a function of latitude.

In order to locate the true cosmic-ray equator, the cosmic-ray cutoff rigidities are considered as a surface. Two programs calculate the first and second derivatives of vertical cutoff rigidity with respect to both latitude and longitude.

Program I computes first and second partial derivatives at points every 5° in latitude and 5° in longitude along a band with width ranging from -20° latitude to 15° latitude and ranging from 0° longitude to 345° longitude.

In both programs, first derivatives are approximated by the spline fit method and second derivatives are approximated by taking the first finite difference of the first derivative.

TITLE: OGO-F Telemetered Data Reduction
AUTHOR: Wright, W.

INITIATOR: Bedo, D. (LKO)
PROJECT: 8688 PROBLEM NO. 1607

HARDWARE/SOFTWARE: IBM 360-50/Fortran IV
MINIMUM CORE SIZE: 32_8k

Telemetered data from Experiment No. 9 of the OGO-F satellite is reduced.

The data is converted internally from 6-bit characters on a 7-track binary tape to 8-bit characters in order to form 32-bit words acceptable to an IBM OS/360.

The program can be modified to include data display and data correcting techniques.

Printed output consists of time subcom information, scan collimator position, samplings of six detectors and vertical/horizontal angles.

TITLE: Electron-Hydrogen Scattering
AUTHOR: Persakis, T.

INITIATOR: Jasperse, J. (LQK)
PROJECT: 5621 PROBLEM NO. 1608

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 20_8k

The purpose of this problem is to provide a study of electron-hydrogen scattering. This program provides a study and graphic representation of the Laguerre and Gegenbauer Sturmian sets of polynomials, which are complete orthonormal sets of functions in the Hilbert space L^2. Corresponding elements from each set are also Fourier Transform pairs, which are used in many quantum mechanical problems as an expansion basis.

TITLE: AFCRL Lunar Laser Control Tape
AUTHOR: Grossman, P.

INITIATOR: Eckhardt, D. (LWG)
PROJECT: 8654 PROBLEM NO. 1609

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV, MAP
MINIMUM CORE SIZE: 14_8k

This program provides a listing of a Moon Ephemeris tape and restructures data for output onto a punched paper tape.

It uses a combination of Lagrangian and least-squares techniques to compute linear approximations to travel time and rate of change of travel time. Since the observations are spaced five minutes apart on the ephemeris tape, a three-point Lagrangian bit is made to three ranges to generate a fourth point midway between the first two. The first two values and the computed range are then fitted to a straight line using a least-square method resulting in the computed initial range and rate of change of range. The data is then prepared for punching onto a paper tape.

TITLE:	Electron Density Distribution in the Ionosphere
AUTHOR:	Armstrong, D.
INITIATOR:	Rush, C. (LII)
PROJECT:	5631 PROBLEM NO. 1610
HARDWARE/SOFTWARE:	IBM 1460, IBM 7094 II-7044 DCS/SPS, Fortran IV
MINIMUM CORE SIZE:	66_8k

There were two tasks to this project. The first task required converting two IBM 360 programs to the DCS. One program, "L6062," was written for the IBM 360/30, and the other, "L8046," was written for the IBM 360/75.

The major steps taken in conversion were as follows:

a. Replacing all literals in the format statements with hollerith information.

b. Since the IBM 360 allows variables to contain greater than 6-character words, arrays had to be placed into DATA statements with alphanumeric information broken up into two words.

The second problem was to write an interpolation routine for "L8046," and include card punching features in both programs.

The main program provides a flexible method of determining the electron density distribution in the ionosphere, and prints out values for plasma frequency, electron density, and true height. The subroutine written for the second project picks out the second height value and rounds it off to the nearest ten greater than or equal to that value. The program then interpolates for the other two quantities for that height and for each height after that in steps of ten, up to the nearest value less than or equal to the Mth value of height.

TITLE:	Ionogram Data Reduction
AUTHOR:	Conway, E.
INITIATOR:	Videberg, J. (LII)
PROJECT:	5631 PROBLEM NO. 1611
HARDWARE/SOFTWARE:	IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE:	25_8k

This program was written for the reduction of ionogram data. The purpose is to convert from virtual height to true height using direct inversion by Schmerling's ten-point approximation method. This program computes the true height for each frequency with virtual height supplied, prints out the true height, and plots true height vs frequency and virtual height vs frequency on one plot. It could be modified to accept other coefficients other than Schmerling's.

TITLE: Harmonic Analysis of Reflected Radio Wave
AUTHOR: Grossman, P.

INITIATOR: Kossey, P. (LIE)
PROJECT: 4603 PROBLEM NO. 1612

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 57_8k

A harmonic analysis is performed on a radio wave reflected from the ionosphere.

The data appears in its raw form as photographs of an oscilloscope waveform. These photographs are enlarged, and tracings are produced and digitized. The program input consists of cards containing the digitized data points plus control information.

Using the control information, the data is first plotted at the same scale as the original tracing, which, with this plot, may be overlaid to determine if the digitized data is a true rendering of the original data.

Then, if necessary, the data is normalized, and a Fourier analysis performed. For the Fourier analysis, the data is padded out with null values as required by the program user.

The amplitudes and phases of the component waveforms are determined, printed, and plotted as a function of frequency. In addition, a noise waveform can be input and subtracted from the radio wave data.

TITLE: Sea Level Pressure Data Analysis
AUTHOR: Wiggins, F.

INITIATOR: Conover, J. (LYS)
PROJECT: 6698 PROBLEM NO. 1613

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 12_8k

Pressure-height readings for June, July and August 1967 and 1968 contained on magnetic tape were reformatted for use on the IBM 7094 II-7044 DCS.

The data was collected from several weather ships and is to be used in predicting weather events in Southeast Asia.

The input data tape contained 334 weather reports per record in BCD format. This data was restructured into 22-word BCD records to be compatible with the output buffer on the IBM 7094 II-7044 DCS.

A listing of each report is made showing date of report, time of report, reporting station and the pressure-height reading.

TITLE: Calculations of Surface Wave Velocity on Crystal Substrates
AUTHOR: Conway, E.

INITIATOR: Slobodnik, A. (LZM)
PROJECT: 5635 PROBLEM NO. 1614

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 75_8k

The purpose of this program is to calculate the surface wave velocity (as well as the power angle, stress, strain, and other associated parameters) on piezoelectric and non-piezoelectric crystal substrates. Surface acoustic waves are important in the development of miniature signal processing devices, especially since surface waves have the ability to be tapped, guided, amplified and otherwise manipulated while on the substrate. These tasks are currently being handled by electromagnetic devices, but these devices require large amounts of cable, which are unwieldy as well as inefficient.

The elastic, dielectric, and piezoelectric constants for the particular crystal substrate under consideration are input to the program. A coordinate system is developed which is independent of the surface under consideration. The differential equations for the mechanical displacements and electric potential are then solved. The other parameters are then readily solved and listings and plots are prepared.

There is the option to have plot output of the following five parameters vs the direction of propagation:

a. surface wave velocity
b. average power flow direction
c. a stress component (T11)
d. the mechanical displacement (U3)
e. the electric displacement (D1)

TITLE: Riometer Data Plots
AUTHOR: Spuria, A.

INITIATOR: Cormier, R. (LII)
PROJECT: 5631 PROBLEM NO. 1615

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 24_8k

"DBIII" plots riometer data. Several sets of data can be submitted for plots at one time. The abscissas of the plots represent sidereal time, and the ordinates represent decibel readings.

TITLE: Measurement of Wind Force and Velocity
AUTHOR: Mazzio, V.

INITIATOR: Wyngaard, J. (LYB)
PROJECT: 7655 PROBLEM NO. 1616

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV
MINIMUM CORE SIZE: 34_8k

The program determines a solution of unknown constant coefficients by means of a least-square fit and outputs the desired solution vector and several intermediate results to check the calculations.

The determination of the program's logic and procedures was developed to be applied to a very restricted and specialized set of data created by the researcher; that is, experimental results from a cup anemometer dynamics study.

TITLE: Pulsating Aurora
AUTHOR: Grossbard, N.

INITIATOR: Moore, J. (LKA)
PROJECT: 7661 PROBLEM NO. 1617

HARDWARE/SOFTWARE: IBM 7094 II-7044 DCS/Fortran IV, MAP
MINIMUM CORE SIZE: 72_8k

Data was read from a radar which picked up the signal from a pulsating aurora. This data was taken at two stations simultaneously. From a time series analysis of the two sets of data, power spectra, cross-spectra, coherency and phase were computed. From the phase results, values for the time delay vs frequency of the pulsating aurora as seen by the two stations were calculated.

The three programs written for this problem all calculate the required information for this problem. Each program uses a slightly different mathematical technique to arrive at its answers. A quick description of the programs follows:

Program 1 uses truncated auto-correlation and cross-correlation functions to calculate the power spectra, cross-spectra, coherency, and phase. In deriving the correlation functions, account is taken (the lags are normalized) of the number of products used to form each lag

Program 2 uses the technique of the first program, but no attempt is made to account for the number of products used to form each lag.

Program 3 uses a direct calculation of the power spectra and cross-spectra. Stability is enhanced by averaging together neighboring values of the spectra.

TITLE: Contour Plotting
AUTHOR: Baker, D.
INITIATOR: Tsipouras, P. (SUYA)

ACCOUNT: 3001
PROBLEM: 01
PROJECT: 0001

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 77_8k

A perspective picture of a surface represented by an array of up to 10,000 data points can be drawn by program "DRAW2." The test case involves sun-surface temperature data, but the program may be applied to any type of data.

The position of the observer, his angles of vision, and the dimensions of the surface (i.e., length and width) are input. The observer must not be anywhere directly over the surface. Because the pro ram does not have any windowing procedure, for best results the observer po tion and his angles of vision should be chosen so that the entire surface fits into cone 45° in all directions from the line of vision. If any part of the surface does not fit into a cone 80° from the line of vision, program errors may result.

A Calcomp plot of the three-dimensional figure is output.

TITLE: Determination of the Mean Lifetime of Excited States of Ions
AUTHOR: Martine, J.
INITIATOR: Cohen, M. (LKO)

ACCOUNT: 3007
PROBLEM: 01
PROJECT: 6688

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 56_8k

A program was written to process data points for the purpose of determining the mean lifetime of excited states of ions produced by collision of an ion beam with a thin foil. The data relates the number of states decaying radiatively to the position downstream of the foil causing the excitation.

The program best-fits the sum of two negative exponentials and a constant to the data. The interpretation of certain of the fitted parameters leads to measurements of the lifetimes of the produced states.

TITLE: Scalar Diffraction Pattern Calculation
AUTHOR: Grossbard, N.
INITIATOR: Gianino, P. (LQR)

ACCOUNT: 3010
PROBLEM: 01
PROJECT: 5621

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 65_8k

The scalar diffraction pattern in space from a circular laser window having radial and azimuthal aberrations is calculated by three programs. Intense laser power incident on the window causes various aberrations, which distort the diffraction pattern in the far field. The object of this calculation is to determine how this distortion develops with time.

"FIJA4" calculates the beamwidth which is the distance off the optic axis within which 90% of the total power is contained.

"FIJAS" calculates the intensity of the light at points along the axis of the window.

"FIACK" computes the intensity of the light at points "X" distance from the axis of the window for "R" distance along the axis of the window.

TITLE: Diffraction Pattern of Laser Beam Through Cylindrical Window
AUTHOR: Grossbard, N.
INITIATOR: Gianino, P. (LQR)

ACCOUNT: 3010
PROBLEM: 02
PROJECT: 5621

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 110_8k

Two programs calculate the diffraction pattern in space caused by a laser beam through a cylindrical window. The vector nature of the electric fields incident on the window are taken into account.

In general, the laser radiation on the window will have polarizations along the radial and azimuthal directions. The object of this calculation is to determine how each of these polarizations will contribute to the diffraction pattern in the far field as a function of time.

"F1ASK" calculates the diffraction pattern at varying distances off the optical axis of the window, at a set distance from the window, and "F1JKS" calculates the diffraction pattern on the window's axis itself. Printed output and Calcomp plots of the intensity of light versus the distance along the window's axis are output for a particular time.

TITLE:	Harmonic Entrainment of Van der Pol Oscillations
AUTHOR:	Persakis, T.
INITIATOR:	Dewan, E. (LRS)
ACCOUNT:	3012
PROBLEM:	01
PROJECT:	5628
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	61_8k

A program was written to aid in the resolution of the controversy concerning the physical interpretation of entrainment of van der Pol oscillations. As originally defined by van der Pol, entrainment occurs when the output frequency and input frequency of an oscillator are equal. The term "asynchronous quenching" (introduced by Kobsarev) refers to the suppression of self-generated oscillations by a non-resonant driving force. The controversy arises from the argument that asynchronous quenching and entrainment are identical phenomena. Minorsky, however, argued that entrainment is a resonance phenomenon occurring (in the case of harmonic resonance, for example, only in a narrow band around the natural frequency, whereas asynchronous quenching occurs only outside resonances. The width of these bands remained unspecified.

The response curves for a certain range of parameters bend back upon themselves. From the quantitative material available from such graphs, one can plot the outline of a region which defines phase locking as opposed to asynchronous quenching. The program evaluates the response curves of the inhomogeneous van der Pol equation and plots zones of stability properties on these curves.

TITLE:	Parameter Plane Trajectory of Inhomogeneous Van der Pol Equations
AUTHOR:	Persakis, T.
INITIATOR:	Dewan, E. (LRS)
ACCOUNT:	3012
PROBLEM:	02
PROJECT:	5628
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	63_8k

This problem deals with the exploration of the behavior of phase-locked and asynchronously quenched oscillations in terms of the solution parameters as determined by the size of the driving term and detuning factor.

The output consists of printed values for strength of driving and phase of output relative to input, plus Calcomp plots of the solution of the inhomogeneous van der Pol equation in polar orientation.

TITLE:	Lunar Coordinate Refinement
AUTHOR:	Dieter, K.
INITIATOR:	Eckhardt, D. (LWG)
ACCOUNT:	3013
PROBLEM:	01
PROJECT:	8607
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	116_8k

A method for the estimation of the dynamic and geometric figures of the moon from lunar plates which are photographed from the earth is studied. Primarily, the study concerns a statistical technique for the estimation of two independent physical libration constants and, consequently, for the estimation of a first-order dynamic figure of the moon. In the same reduction, the relative locations on a number of control points on the moon's surface are also estimated. The control points are samples of the true lunar surface, so that a simple geometric surface fit to these points is a low order or smooth model of the geometric figure of the moon.

The procedures used in the program to refine lunar coordinates can also be employed to analyze similar data for landmarks on the surface of the earth as seen, for example, from the moon or an earth satellite.

A matrix is set up and inverted. The inverse matrix is multiplied by a vector, forming a new vector, which is corrected, checked for convergence, then multiplied by the matrix. This iterative process continues until the convergence criteria are satisfied.

The crater coordinates, the plate angles, and the libration parameters are printed as soon as convergence appears.

TITLE: Analysis of Ionospheric Irregularities
AUTHOR: Grossbard, N.
INITIATOR: Elkins, T. (LIR)

ACCOUNT: 3014
PROBLEM: 01
PROJECT: 4643

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 140_8k

Satellite beacon transmissions are used for the study of ionospheric irregularities. Power spectrum and bispectrum analysis of the time series of a beacon signal facilitate the determination of fluctuations that the ionospheric irregularities introduce into these transmissions. This problem consists of three programs which are basically conversions of IBM 7094 II-7044 DCS programs of Problem No. 1396 to the CDC 6600. "F1OPA" is a conversion and modification of program "GEO PARAMETER." It finds the drift velocity of electrons in the ionosphere, analyzing three or more simultaneous time series, performing auto- and cross-correlations.

"F1OSS" is a conversion of "KKPL," and analyzes fluctuations of radio signals from a satellite to a ground station to determine the nature of changes in the scattering of radio signals by the atmosphere. "F1NBI" is a modification of "F1OSS," and it attempts to identify variations in the electron density of the ionosphere.

TITLE: Fluctuations of Radio Signals in the Atmosphere
AUTHOR: Grossbard, N.
INITIATOR: Elkins, T. (LIR)

ACCOUNT: 3014
PROBLEM: 02
PROJECT: 4643

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 74_8k

A program was written to analyze the fluctuations of radio signals from a satellite to a ground station. The study of these scintillations aid in the determination of variations in the scattering of radio signals by the atmosphere. A bispectrum and its associated Fourier power and phase spectra are calculated. The input data, consisting of amplitudes of radio signals versus time, are printed, and a contour plot of the calculated double Fourier series is generated.

TITLE:	Spatial Variability--Uniformly Stationary Stochastic Process
AUTHOR:	Boudreau, R.
INITIATOR:	Gringorten, I. (LKI)
ACCOUNT:	3017
PROBLEM:	01
PROJECT:	8624
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	74_8k

The characteristics of the correlation coefficients between any two values in a homogeneous two-dimensional field are determined as a function of the distances between the two values. The result is used to determine the limiting stationary form of a simulated stochastic process on a normal variable. The limiting value of correlation approached with respect to distance is of particular interest.

Plots of correlation coefficient versus distance are generated automatically at given intervals of calculation in order to present graphically the general decay characteristics of correlation.

The application to meteorology is to relate the probability of a local event of the weather to its probability in a larger area.

TITLE:	Probability Distribution of Spatial Minima in Two Dimensions
AUTHOR:	Boudreau, R.
INITIATOR:	Gringorten, I. (LKI)
ACCOUNT:	3017
PROBLEM:	02
PROJECT:	8624
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	47_8k

The investigation of the spatial variability of a uniformly stochastic process is continued. In the first part of this study, the behavioral characteristics of correlation coefficients of a defined stochastic process were determined. The purpose of this continuation is to find the probability distribution of the minimum value of the normal (Gaussian) variable (y) defined by the original stochastic process. In addition, the synoptic field of values of y is studied to determine its minimum in areas.

The meteorological goal is to relate the probability of the occurrence of a local event, like rain on a barn, to its probability over a large area, such as a city or state. Also, the solution will help to determine the probability of an airplane encountering hail along a flight path compared with the probability of hail at some single point on the path.

TITLE:	Spatial Variability--Probability Distribution of Minimum Gaussian Value
AUTHOR:	Boudreau, R.
INITIATOR:	Gringorten, I. (LKI)
ACCOUNT:	3017
PROBLEM:	03
PROJECT:	8624
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	47_8k

A program was written to find the probability distribution of the minimum value of a normal Gaussian variable that has a value obtained stochastically at each point along a straight line of length "S." The stochastic process is repeated a sufficient number of times to give the frequency distribution a high degree of accuracy.

The meteorological goal is to relate the probability of a local event, such as hail, to the probability of encountering the local event along a flight path.

TITLE:	Analysis of OSO Vehicle Data
AUTHOR:	Vicksell, F.
INITIATOR:	Hinteregger, H. (LKO)
ACCOUNT:	3019
PROBLEM:	01
PROJECT:	6688
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	77_8k

"OSO-1970" of Problem Number 1163B has been converted to the CDC 6600. The purpose of this project is to process OSO-III data tapes and ephemeris tapes provided for the study of solar emissions and the determination of high-altitude earth atmosphere composition and temperature.

The program reduces OSO-III Experiment 22 solar ultraviolet measurement data. Its purpose is to provide the ability to view the telemetered data from the OSO-III satellite in a variety of plotted and printed formats, and further, to combine the data with orbital information and do the computations necessary to arrive at estimated atmospherical optical depths and scale heights as a function of probing height, for various wavelengths at different latitudes, longitudes and at different seasons of the year.

TITLE:	Correlation of Reflectivity and Attenuation
AUTHOR:	Grossbard, N.
INITIATOR:	Joss, J. (LYW)
ACCOUNT:	3021
PROBLEM:	01
PROJECT:	6672
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	57_8k

Correlation of reflectivity and attenuation measured by three vertically pointing radars is performed. The three radars are of different wavelengths and are sampled in sequence at 30 ranges. The data is recorded on digital tape.

At first, "N" successive samples of a given range are averaged. Then, only the signals being significantly above noise are processed and corrected for range. The results thus obtained consist of absolute reflectivity values for the three wavelengths, which are chosen so that the signals of the first radar are strongly attenuated, of the second one are weakly attenuated and of the third are unattenuated.

This program is a conversion of the DCS program "F1DUM" written under Problem Number 1279. In addition to conversion, the distribution of the output results is displayed by a series of CRT plots of height versus reflectivity. Three graphs, representing the results for the three wavelengths, are displayed on each plot, and the plots are output at the times at which the reflectivity values are printed.

TITLE:	Use of Radar in Precipitation Studies
AUTHOR:	Grossbard, N.
INITIATOR:	Joss, J. (LYW)
ACCOUNT:	3021
PROBLEM:	02
PROJECT:	6672
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	40_8k

This program was written as part of a study to explore the possibilities and limitations of doppler radar in investigating precipitation phenomena. In particular, the velocity and drop size during precipitation are analyzed. The results, consisting of radar intensity values versus frequency, are printed, with each line of print-out representing an instant of time.

TITLE:	Linear Ground Plane Plasma Model
AUTHOR:	Mazzola, S.
INITIATOR:	Fante, R. (LZP)
ACCOUNT:	3026
PROBLEM:	01
PROJECT:	4642
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	165_8k

An outside program written for the IBM 360-75 computer is converted to the AFCRL CDC 6600. The program calculates the admittance, isolation and radiation pattern for rectangular slots in a ground plane covered by an outwardly inhomogeneous plasma. The purpose is to study the effect of a plasma formed on a vehicle-mounted antenna system as it enters the earth's atmosphere.

TITLE:	Admittance Parameters for Plasma-Covered, Cavity-Backed Slot Antenna
AUTHOR:	Lonergan, F.
INITIATOR:	Fante, R. (LZP)
ACCOUNT:	3026
PROBLEM:	02
PROJECT:	4642
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	45_8k

The effects of the reentry plasma sheath on microwave antenna performance are derived from Trailblazer II rocket results of 18 June, 1967.

The turns ratio and the probe reactance of the equivalent circuit for a slot antenna when the antenna is matched to free space are calculated. Then these parameters are used to compute self-admittance, mutual admittance, isolation, attenuation, reflection coefficient and voltage standing wave ratio at the probe for a pair of cavity-backed slots covered with different plasmas.

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TITLE:	Determination of Drag on Cannonball II
AUTHOR:	Grossbard, N.
INITIATOR:	Marcos, F. (LKB)
ACCOUNT:	3027
PROBLEM:	01
PROJECT:	6690
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	120_8k

Accelerations, measured by accelerometers on the Cannonball II satellite, are caused by the spinning and tumbling of the satellite as well as the drag of the surrounding atmosphere on the satellite. A computer program was written to filter out that portion of the accelerometer data which resulted from the spinning and tumbling, while modifying the data resulting from drag as little as possible for the purpose of determining the amount of drag. The drag data will provide an estimation of the density of the atmosphere. The results are both printed and plotted, with drag versus time.

TITLE:	Analysis of Upper Atmospheric Wind Data
AUTHOR:	Vicksell, F.
INITIATOR:	Pfister, W. (LI)
ACCOUNT:	3028
PROBLEM:	02
PROJECT:	7663
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	100_8k

A three-spaced antenna recording system has been in operation in Billerica, Massachusetts, since 1965 under the combined direction of the AFCRL Ionospheric Physics Laboratory and Lowell Technological Institute Research Foundation (LTIRF). Amplitude data of ionospheric drift motions are originally recorded in analog form and subsequently digitized for the purpose of analysis with the use of a large-scale digital scientific computer.

Several DCS programs written under Problem Number 1417 assisted the Ionospheric Physics Laboratory in the modular analysis of the turbulence characteristics and structure of the upper atmosphere.

Problem Number 1417 has been partially converted from the IBM 7094 II-7044 DCS to the CDC 6600. Digitized tapes containing amplitude and phase data supplied by Lowell Technological Institute are processed by extracting, editing and smoothing the amplitude data. Spectral analysis is performed on the revised data for a study of diurnal and seasonal variations in ionospheric conditions.

In addition, the real auto and cross-correlations, which form the basis of wind characteristic analysis, are performed on both the amplitude and phase data. The real and imaginary parts of the complex cross and auto-correlations are calculated, and related power spectra are generated for use in the analysis of drift motions of the ionosphere and as input to a model which can be used to define the turbulence characteristics of the ionospheric layers.

TITLE: Analysis of Upper Atmospheric Wind Data -- Modification
AUTHOR: Vicksell, F.
INITIATOR: Pfister, W. (LI)

ACCOUNT: 3028
PROBLEM: 02 Modification: A
PROJECT: 7663

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 60_8k

Programs "WINDPAC" and "AA67" of Problem No. 3028, 02, have been modified to handle phase data contained on tapes dated 1967 and later as well as amplitude data on tapes dated 1965 and 1966. To accomplish these changes "WP PHASE CAL 67" of Problem No. 1417A was converted and included in the modified "WINDPAC."

The present function of "WINDPAC" is to read digitized tapes containing ionospheric data supplied by Lowell Technological Institute. The desired amplitude data is extracted, the errors are removed, the data is smoothed, and the results are rewritten onto new tapes in a compact form to be input for analysis by "AA65," of No. 3028,02. In addition, the phase data may be extracted, calibrated, smoothed and included with the amplitudes on the output tape for use by "AA67," which performs the real auto and cross-correlations on the amplitude and phase data and produces the data on punched output. Calibration curves of normalized phase magnitude versus sum of frequency of occurrence may be output on the Calcomp plotter.

TITLE: Representative Inverse Velocity Surface
AUTHOR: Kellaher, J.
INITIATOR: Szabo, T. (LZ)

ACCOUNT: 3032
PROBLEM: 02
PROJECT: 5635

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 50_8k

An inverse anistropic velocity surface was modeled to represent a heterogeneous anistropic medium. The new surface was used to determine paths of acoustic rays propagating through the medium. When anistropic inverse velocity surfaces are known at increments of distance, ΔZ, each surface contains inverse velocity values, VI(I), for one-degree increments of an angle theta. Each angle has a different inverse velocity value for each surface. Then, if all these values are integrated over the interval, a velocity is created representing the heterogeneous velocities in the direction of theta. If this integration is carried out for each angle, the result is an inverse velocity surface representing all the given surfaces. Integration will be by the trapezoidal rule or Simpson's rule, or both.

TITLE: Atmospheric Turbidity
AUTHOR: Persakis, T.
INITIATOR: Volz, F. (OPA)

ACCOUNT: 3034
PROBLEM: 01
PROJECT: 7621

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 41_8k

Aerosol attenuation and water vapor amount are computed from measurements of solar radiation at several wavelengths. The solar data samples are gathered at AFCRL and by the Air Weather Service at several tropical stations.

The input, consisting of daily spectral solar intensity measurements, is furnished on punched cards. Spectral aerosol attenuation coefficients are derived by subtracting molecular attenuation, and the water vapor amount is computed. The turbidity values are plotted on a monthly and annual basis, with the range on a logarithmic scale versus the days on a linear scale.

The turbidity data is useful in studies of optics, climatology, and chemistry of aerosol. They also provide background data for Air Force problems related to atmospheric transmission and contrast transmission.

TITLE: Analytical Analysis of Ice Cylinder Rainbow-Supernumeraries
AUTHOR: Martine, J.
INITIATOR: Bird, R. (OPA)

ACCOUNT: 3036
PROBLEM: 02
PROJECT: 7621

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 52_8k

The positions of the maxima and minima of the supernumerary rainbows in light scattered from an infinite cylinder in the normal plane can be found from exact theory. The purpose of this effort is to compare the results obtained from geometrical optics with the results obtained from this exact theory, and to determine where geometrical optics give meaningful results.

The solution of the geometrical optics approach requires the solution of a system of simultaneous non-linear equations.

TITLE: Electromagnetic Waves in a Magnetoplasma
AUTHOR: Lindstrom, P.
INITIATOR: Papa, R. (LZP)

ACCOUNT: 3037
PROBLEM: 01
PROJECT: 4642

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 47_8k

Two programs were written to improve the accuracy of integration routines used in previous programs written under Problem Number 1550, which facilitates the determination of how waves propagating in a plasma will attenuate and distort.

The Gauss quadrature routines apparently are accurate for some ranges of the parameters for single integrations, but not for double integrations required. The accuracy of certain calculated values is improved, certain double integrals produced under No. 1550 are reduced to single integrals, and the contours for all single integrals are deformed in order to minimize the oscillatory nature of the integrands. Also, the integrands are rewritten to reduce the number of arithmetic operations.

The data derived from this study will be useful in the design of radio communication systems in which waves must propagate through an intervening plasma system.

TITLE: Dynamic Model of the Thermosphere
AUTHOR: Russell, J.
INITIATOR: Forbes, J. (LKB)

ACCOUNT: 3041
PROBLEM: 01
PROJECT: 6690

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 50_8k

A program was written to study the dynamic characteristics of the thermosphere in relation to the fields of density, temperature and pressure; energy sources and sinks in the thermosphere; energy transport; and effects on atmospheric structure.

The equations of motion, continuity, and thermal energy for compressible viscous flow in a pressure frame, and extended to include the ion-drag and coriolis effects, have been formulated and simplified to describe appropriately the geophysical problem under study. The driving force for this system of partial differential equations is an arbitrary heat source which may be a function of altitude, longitude, latitude and time. The task of this program is to solve this system of partial differential equations for several heat sources of interest.

The input parameters, special angle, time, velocity components, density, temperature, pressure, altitude, and an altitude or pressure parameter are printed.

TITLE: Ion Particle Motion in a Tormac Magnetic Field
AUTHOR: Lonergan, F.
INITIATOR: Levine, M. (PHP)

ACCOUNT: 3046
PROBLEM: 01
PROJECT: 8659

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 45_8k

The containment of an ionized gas or plasma in the tormac magnetic field is dominated by the behavior of ions in the sheath regions. An analytic expression for the shape of the magnetic field has been obtained in the sheath regions S_1, S_2, S_3 and S_4. With the magnetic field thus defined, the motion of particles in this magnetic field will determine the rate of loss from the tormac containment device.

There are actually two magnetic fields, B(Z) and $\widetilde{\text{BIN}}$(Z), studied here. By definition, a magnetic field is a complex-valued function whose domain is a subset of a complex plane. There are three programs in this study. "S4RMC" evaluates the field lines of the field B(Z), "S4RMC" evaluates the field lines of the field $\widetilde{\text{BIN}}$(Z), and "BIQ" calculates the distance of a point in the sheath regions S_1 to the astroid $X^{2/3} + Y^{2/3} = 1$.

"BIQ" can be modified to accommodate the Newton-Raphson Method in finding the root of a polynomial equation.

TITLE:	TRACE-66 Trajectory Analysis Development
AUTHOR:	Stoll, D.
INITIATOR:	Hussey, I. (SUYA)
ACCOUNT:	3501
PROBLEM:	01
PROJECT:	0001
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	45_8k

The TRACE-66 Trajectory Analysis and Orbit Determination Program is a general-purpose orbital analysis program used in the analysis and design of satellite orbits and tracking systems. This system was acquired from the Aerospace Corporation.

The major areas of application include Orbit Determination, Vehicle Ephemeris Generation, Simulated Measurement Data Generation and Orbital Statistics via covariance analysis. Program "X2926" was written to assist in preparation of observation input data to "TRACE-66.' The program converts a deck of 029 observation data to 026 format. The program is in a general form to allow converting any deck from 029 to 026 format. This is the first in a series of programs that will be necessary to adapt "TRACE-66" to the CDC 6600 computer system.

TITLE:	Prediction of Eclipse Circumstances
AUTHOR:	Bhavnani, K.
INITIATOR:	Hussey, I. (SUYA)
ACCOUNT:	3501
PROBLEM:	04
PROJECT:	0001
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	45_8k

Prediction of eclipse circumstances at any geographic location and altitude requires knowledge of solar and lunar ephemerides. For AFCRL's purposes, a reasonably high degree of accuracy is required. Subroutine "SLEPHEM" provides accuracy to better than one second of arc or a few tenths of a second in time. As a function of ephemeris time, the subroutine returns all necessary quantities, such as, longitude, latitude, nutation, obliquity of the elliptic, right ascension, declination, parallax, semidiameter, heliographic coordinates, and ephemeris sidereal time.

Two support programs, "DMSTRAD" and "EPHCON" convert all angular constants in the equations to radians before implementation of the subroutine.

TITLE:	1966 Standard Atmospheric Model--Orbit Determination
AUTHOR:	Vicksell, F.
INITIATOR:	Hussey, I. (SUYA)
ACCOUNT:	3501
PROBLEM:	05
PROJECT:	0001
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	45_8k

A family of exponential temperature curves is the basic defining parameter of the Supplementary Atmospheres above 120 km. These temperature curves are derived empirically in order to provide density-altitude profiles which are in agreement with satellite-drag derived densities for various degrees of solar and geomagnetic activity and varying solar angles. Jacchia (1965) defined such a family of atmospheres for one boundary condition of temperature, pressure, density and molecular weight at its base, 120 km. This family of atmospheres can be considered to represent the annual mean or spring and fall conditions in lower layers. However, because the eight supplementary atmospheres below 120 km converge at three separate boundary conditions at 120 km, new mathematical treatment was needed to join these families realistically.

The above model (derived from "Part 3--Atmospheric Models Above 120 Kilometers," U.S. Standard Atmosphere Supplements, 1966) was the model for the calculation of atmospheric densities, which is performed by a set of subroutines. The package was designed particularly for use in orbital programs on the CDC 6600 computer.

Printed output consists of the 7 cm solar flux averaged over three solar rotations, nighttime global minimum value of exospheric temperature averaged over three solar rotations, date, season, table of daily 10.7 cm solar fluxes, temperature adjusted for daily solar activity, temperature adjusted for semi-annual variation, geomagnetic index, the change in temperature computed from the geomagnetic indices, and time lag of effect of geomagnetic activity in hours.

In addition, this model atmosphere was incorporated into a version of the Orbit Determination System.

TITLE: Computation of Heliographic Coordinates
AUTHOR: Boudreau, R.
INITIATOR: Hussey, I. (SUYA)

ACCOUNT: 3501
PROBLEM: 06
PROJECT: 0001

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 50_8k

Program "ISHEL" was written to provide consecutive dates as input to Subroutine "HELCSTP," also included in this problem number. "HELCSTP" calculates the heliographic coordinates of the subterrestrial point (center of solar disk) and position angle of the northern extremity of the sun's axis of rotation for a specified date and universal time. The main program prints out the daily heliographic coordinates and the position angles for each month.

TITLE: Satellite Velocity and Radius
AUTHOR: Almon, A.
INITIATOR: Almon, A. (SUYA)

ACCOUNT: 3503
PROBLEM: 01
PROJECT: 0001

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 45_8k

Given the apogee, perigee, inclination and latitude of a satellite, "APOPER" computes the radius in feet and the velocity in feet per second of the satellite.

The program, as set up, requires the CDC 6600 to be accessed through the Bell System Teletypewriter. The apogee and perigee can be accepted in the form of either kilometers or nautical miles.

The printout includes the azimuth in all four quadrants, as well as the radius and velocity.

TITLE:	Setup and Maintenance of Orbital Archives
AUTHOR:	Roehrig, H.
INITIATOR:	Roehrig, H. (SUYA)
ACCOUNT:	3504
PROBLEM:	01
PROJECT:	0001
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	50_8k

Selected experimental satellite observation and catalog element set data are required on a continuing basis to support AFSC SBAR (Satellites, Balloons and Rockets) programs within the AFCRL complex. The data, as received, is converted and/or reformatted for magnetic tape processing on the AFCRL in-house CDC 6600 computer. The reformatted data is edited, corrected where possible, sorted and stored on magnetic tape for merging with data in the permanent orbital archives. The orbital archives comprised two separate files--satellite and time order.

TITLE:	Cannonball 2 Prelaunch Development
AUTHOR:	Bhavnani, K.
INITIATOR:	Marcos, F. (LKB)
ACCOUNT:	3506
PROBLEM:	01
PROJECT:	6690
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	60_8k

"RDPUNCH" was developed as part of the prelaunch development on the Cannonball 2 satellite for processing standard C-BAND radar data on magnetic tapes. "RDPUNCH" is a modification of "RADPLOT" of Problem No. 1494 and provides printed and punched output in "SPADATS" format. The output includes time, range, azimuth, elevation and altitude for specified intervals throughout the orbit.

TITLE:	Musketball Prelaunch Development
AUTHOR:	Bhavnani, K.
INITIATOR:	Marcos, F. (LKB)
ACCOUNT:	3506
PROBLEM:	02
PROJECT:	6690
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	60_8k

"RDPUNCH" was developed as part of the prelaunch development on the Musketball satellite for processing standard C-BAND radar data on magnetic tapes. This program is a modification of "RADPLOT" of Problem No. 1494 and provides printed and punched output in "SPADATS" format. The output includes time, range, azimuth, elevation and altitude for specified intervals throughout the orbit.

TITLE:	Correction of Geomagnetic Coordinates and Geomagnetic Time
AUTHOR:	Hurwitz, M.
INITIATOR:	Buchau, J. (LIB)
ACCOUNT:	3508
PROBLEM:	01
PROJECT:	5631
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	47_8k

Airborne measurements in the Arctic require that instantaneous aircraft location, given in Universal Time (UT) and geographic coordinates, be known in corrected geomagnetic time (CGT). Program "CGLLT" accepts UT and geographic coordinates for a position point and outputs the corresponding corrected geomagnetic coordinates and corrected geomagnetic time. The program is a shortened version of "TRK2" of Problem No. 3508, 3.

TITLE:	Corrected Geomagnetic Coordinates Inversion
AUTHOR:	Hurwitz, M.
INITIATOR:	Buchau, J. (LIB)
ACCOUNT:	3508
PROBLEM:	02
PROJECT:	5631
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	110_8k

"INVT" inverts the table of corrected geomagnetic (CG) coordinates (taken from A Revised Corrected Geomagnetic Coordinate System, Gustafsson, G.) as a function of geographic coordinates. Its results will be used to transfer CG coordinates to their geographic equivalents.

TITLE:	Calculation of Satellite and Aircraft Flight Tracks
AUTHOR:	Hurwitz, M.
INITIATOR:	Buchau, J. (LIB)
ACCOUNT:	3508
PROBLEM:	03
PROJECT:	5631
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	115_8k

Five programs provide for the tracking of aircraft or satellites in corrected geomagnetic coordinate systems as a function of various parameters.

"SATSRT" reads an ALOSYN satellite data tape obtained from the Canadian Defense Department and sorts the data records by year, season, magnetic activity index, F-layer plasma frequency, and Universal Time. This data is plotted by "SATSPT" on Calcomp plots.

"ALTRAK" generates plots of plasma frequency as a function of corrected geomagnetic latitude time in a polar coordinate frame of reference.

Airborne measurements in the Arctic require that the instantaneous aircraft location, given in Universal Time (U.T.) and geographic coordinates, be expressed in corrected geomagnetic coordinates (CGM) and corrected geomagnetic time (CGT).

"SATRAK" accepts the U.T. and geographic coordinates for the end points of a satellite flight and generates the CGM and CGT's at one-minute intervals in U.T., whereas "CGTRACK" accepts the U.T. and geographic coordinates for the end points of an aircraft flight and generates the CGM and CGT's at one-minute intervals.

TITLE: Orbit Determination and Ephemeris Computation
AUTHOR: Whelan, L.
INITIATOR: Hadgigeorge, G. (LWG)

ACCOUNT: 3509
PROBLEM: 01
PROJECT: 7600

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 110_8k

The Orbit Determination and Ephemeris Computation program written under Problem No. 1011 was modified to write formatted satellite information, consisting of identification, azimuth and elevation information, onto mass storage for input to two satellite laser ranging programs (written under Problem No. 4003, 2) each of which produces a punched paper tape. The tapes are then used to drive a pedestal, which directs the beam of the laser it supports. The paper-tape-punch programs and the modified Orbit Determination and Ephemeris Computation program have been combined in this problem number.

TITLE: Black Brant Rocket Trajectory Position Data Analysis
AUTHOR: Dieter, K.
INITIATOR: Smiddy, M. (LIB)

ACCOUNT: 3525
PROBLEM: 01
PROJECT: 8617

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 120_8k

The Black Brant rocket number 18.82 was launched March 26, 1970, from Ft. Churchill, Canada. Rocket trajectory position data is generated from raw radar tracking data received from this rocket launch facility. The radar data, consisting of time, azimuth, elevation and slant range, is analyzed to compute position, velocity, acceleration, altitude, latitude and longitude.

The radar data is used as input, via magnetic tape, to a trajectory program, which was originally written for the DCS under Problem Number 1236. This trajectory program has been converted to the CDC, and is described under Number 4008, 1.

TITLE: Visibility Statistics
AUTHOR: Almon, A.
INITIATOR: Bertoni, E. (LKI)

ACCOUNT: 3526
PROBLEM: 01
PROJECT: 8624

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 55_8k

A program was written to provide the user with visibility statistics for any latitude-longitude grid for altitudes lower than 2500; 2500-4999; 5000-9999; 10,000-14,999; 15,000-24,999; 25,000-34,999; 35,000-44,999 and higher than 45,000 feet. The data was collected from observations made from aircraft at angles to the horizon and +30, +60, -30 and -60 degrees to the horizon. All observations were put onto magnetic tape for easier handling.

A data summation of each category is made, and their totals are totaled. This final total is divided into the three totals 1, 2 or 3, and the probabilities are printed.

TITLE: Determination of Eclipse Parameters
AUTHOR: Stancik, J.
INITIATOR: Cronin, E. (SUYA)

ACCOUNT: 3527
PROBLEM: 01
PROJECT: 0001

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 110_8k

Two programs written for an IBM 360 computer and supplied by the Goddard Space Flight Center are converted to the CDC 6600.

Program "TREC" computes eclipse parameters for a given rocket trajectory. Program "SOAR" computes eclipse parameters and determines the angle between the eclipse shadow axis and the longitudinal axis of the rocket.

TITLE:	Hybrid Spectral Analysis
ANALYSTS:	Prof. O. Kennedy, Dr. A. Morruzi, Dr. D. Eteson
INITIATOR:	Cronin, E. (SUYA)
ACCOUNT:	9000
PROBLEM:	01
PROJECT:	0001
HARDWARE/SOFTWARE:	EAI 8900/Fortran IV, Assembly Code
MINIMUM CORE SIZE:	32_8k

A data analysis program which utilizes the analog, digital and linkage capabilities of the AFCRL EAI 8900 hybrid computer was completed under Contract No. F19628-69-C-0125. This hybrid computer simulation calculates various measures and statistical properties of two signals, and continuously, or repetitively, displays these results on an oscilloscope or stripchart recorder. The analog portion of the program continuously computes the following:

a) Average values

b) Deviations from the average

c) RMS values

d) Average cross products and correlation coefficient

The digital portion of the program repetitively calculates approximations to the following statistical properties:

a) Discrete amplitude probability density

b) Cross-correlation

A "Hybrid Set-Up" program is provided to set all potentiometers and perform a static check. This program calculates the appropriate potentiometer settings based on a value of averaging time which the operator specifies via the console typewriter. For the digital, program parameters such as sampling rate, number of samples in the data base, output-scale factor, etc., are entered in a similar fashion; the operator may interact with the program and change selected parameters by means of the 8400 console register switches.

TITLE: Specialized Signal Analysis
ANALYST: Fasano, J.
INITIATOR: Paulsen, E. (LYW)

ACCOUNT: 9002
PROBLEM: 01
PROJECT: 6690

HARDWARE/SOFTWARE: EAI 8900/Fortran IV, Assembly Code
MINIMUM CORE SIZE: 19_8k

An AFCRL EAI 8900 hybrid computer simulation recovered experimental data received as a telemetered multiplexed signal. Phase lag and time elapse measurements of this data were made using time-scaled analog circuitry whose outputs were displayed on a stripchart recorder. A subcarrier data signal was sampled into digital memory by way of the A-D linkage and referenced to IRIG-B time through the Systron-Donner Time Code-Generator interface. A digital program mapped these points into a plane required for further analysis. A magnetic tape was made along with stripchart recordings and digital printout for cross-reference.

TITLE: Evaluation of Rocket Data Noise
ANALYST: Fasano, J.
INITIATOR: Weeks, L. (LKB)

ACCOUNT: 9003
PROBLEM: 01
PROJECT: 6690

HARDWARE/SOFTWARE: EAI 8800 only
MINIMUM CORE SIZE: N/A

The purpose of this effort was to determine the existence of a recoverable signal on Link 1, IRIG Channel 17 of rocket flight A07.024-1. Previous analysis by digital methods produced results which did not agree with known behavior. The range tape of the received multiplexed signal was investigated using the AFCRL EAI 8900 hybrid computer to resolve the differences as either telemetry/instrumentation or aliasing errors. If aliasing, then further analysis would be warranted.

The simulation separated Link 1 from the multiplexed signal which was received during this rocket flight. Analog circuitry recovered the experimental data without variance from expected results. Peak detection and the experimental data were displayed as stripchart recordings.

TITLE: Reduction of Data from Filter Wheel Radiometer
ANALYST: Fasano, J.
INITIATOR: Good, E. (LKC)

ACCOUNT: 9004
PROBLEM: 01
PROJECT: 7635

HARDWARE/SOFTWARE: EAI 8900/Fortran IV, Assembly Code
MINIMUM CORE SIZE: 11_8k

An AFCRL EAI 8900 hybrid computer simulation separated subcarrier frequencies of a multiplexed signal telemetered during a rocket flight to acquire atmospheric atomic oxygen density. This hybrid simulation recovered the experimental data as a continuous signal. Analog circuitry was time-scaled for convenient peak-to-peak measurements of the max/min excursions of this data. This output was stored in digital memory using the linkage capability of the hybrid computer. IRIG B flight time of the peak occurrences was also read into digital memory via the interface to the Systron-Donner Time Code Generator-Reader 8150. This data was stored onto magnetic tape for input to the CDC 6600.

TITLE: Orbiting Vehicle Simulation
ANALYSTS: Electronic Associates, Inc. and Martin-Marietta Corporation
INITIATOR: Cronin, E. (SUYA)

ACCOUNT: 9005
PROBLEM: 01
PROJECT: 0001

HARDWARE/SOFTWARE: EAI 8900, EAI 231R/Fortran IV, Assembly Code
MINIMUM CORE SIZE: 32_8k

A hybrid mathematical model for studying and evaluating perturbative effects and decay predictions on an orbiting vehicle has been developed. The atmospheric model currently being used, both in the analog and digital portions, is the 1966 Standard Supplement, with other models of interest to be incorporated. Selection of the analog or digital model is a user's option, selected at the console register; analog, when density characteristics are being studied, and digital, when decay predictions are being made.

Up to eight variables of interest may be plotted simultaneously during the computation, which proceeds at approximately four thousand times real-time.

TITLE:	Analog Simulation of Transmission through a Time-Varying Layer
ANALYST:	Fasano, J.
INITIATOR:	Fante, R. (LZP)
ACCOUNT:	9007
PROBLEM:	01
PROJECT:	5635
HARDWARE/SOFTWARE:	EAI 8800 only
MINIMUM CORE SIZE:	N/A

An analog simulation program has been developed to study transmission through a time-varying medium. This computer simulation determines the transmission through and reflection from a spatially homogeneous dielectric slab in which permittivity and permeability are arbitrary functions of time.

A loss-less transmission line, with time-varying inductors and capacitors, was used as the math model for this dynamic medium. The behavior of this network was defined through the notion of state, since the state-vector differential equation permits access to those intermediate variables associated with each line section. In this manner, the traveling wave and reflections can be monitored on an oscilloscope as the operator interacts with the program, changing selected parameters to achieve a desired design.

This analog program has been implemented on the Martin-Marietta expanded version of the AFCRL Hybrid Computer.

TITLE:	Ionospheric Ray Tracing
ANALYST:	Electronic Associates, Inc.
INITIATOR:	Cronin, E. (SUYA)
ACCOUNT:	9012
PROBLEM:	01
PROJECT:	0001
HARDWARE/SOFTWARE:	EAI 8900, EAI 231R/Fortran IV, Assembly Code
MINIMUM CORE SIZE:	32_8k

This program simulates electromagnetic energy ray paths in the ionosphere. The Haselgrove differential equations are integrated to obtain the parametric equations of the ray path in a spherical coordinate system. These computations are done in a geomagnetic system, and the necessary transformations between geographic and geomagnetic coordinates are applied to the inputs and outputs.

The electron density in the ionosphere is computed according to a three-dimensional density model in which second-order Euler interpolation is applied to tabular values of the plasma frequency. The effects of the earth's magnetic field and of electron collisions may be included in or excluded from the calculations of the refractive index. When used, the magnetic field is modelled by an idealized magnetic dipole, and the collision frequency is a function of the height of the ray.

In addition to the ray path coordinates, the program calculates the phase path length, group path length, ray path length, great circle distance and electron density. These results, at specified intervals along the ray path, are printed in tables. A graph of the ray path may also be obtained.

A ray path is determined by specifying a propagation frequency, a transmitter position and an initial azimuth and elevation angle. The program also has an optimization procedure which, for a given frequency, calculates the correct azimuth and elevation to pass a ray from a given transmitter position to a given receiver position.

TITLE:	Analysis of Spectrophotometric Data--Spectrum Study of Aluminum Monoxide by Release of Trimethyl Aluminum at Various Altitudes
PROGRAMMER:	Greco, F.
INITIATOR:	Kitrosser, D. (LKC)
ACCOUNT:	9013
PROBLEM:	01
PROJECT:	7635
HARDWARE/SOFTWARE:	EAI 8900; Fortran IV, Assembly Code
MINIMUM CORE SIZE:	32_8k

Spectrophotometric data was recorded on analog tape in the form of pulses from photon-counting circuitry during a field experiment. A 60 Hz pulse derived from the power supply for a synchronous motor, which scanned the spectrometer, was also recorded. The AFCRL EAI 8900 hybrid computer processed this data to be used as input to the CDC 6600.

TITLE:	Tropical Wind Data Analysis
AUTHOR:	Zubli, D.
INITIATOR:	Conover, J. (LYS)
ACCOUNT:	4002
PROBLEM:	01
PROJECT:	6698
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	50_8k

The origins of the wind circulations that affect precipitation in the area of Tan Son Nhut, South Vietnam, are determined. The results have importance in military maneuvers. The programs developed for this analysis aid the scientist in correlating wind vectors and radar indices.

The analyzed u or v wind-component information from three data tapes supplied by the National Meteorological Center is extracted for days specified by the initiator in order to eliminate defective data. The edited information is written on a magnetic tape by program "PRECOR" and is input to program "CORREL," which computes correlation coefficients of the u and v wind vectors vs radar indices (1) for a period of about three months, and then (2) with a lag of one day for a total of eight day lags. The correlation coefficients are printed in a 23 x 23 geographical grid, representing 70°E to 180°, at 23 latitudes defined within the program.

TITLE: Cloud Intensity Analysis
AUTHOR: Murphy, J.
INITIATOR: Conover, J. (LYS)

ACCOUNT: 4002
PROBLEM: 02
PROJECT: 6698

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 45_8k

Several programs are used in this study. Two programs create a single binary tape for the purpose of correlating the brightness or intensity of clouds and a third program finds the correlation.

Four phases involved in this study consist of the generation of the following:

a. A complete list by computer (Program A) of the daily brightness values for June through September of 1967, 1968 and 1969, ranging from 85° north latitude to 85° south latitude and 0° east longitude to 5° west longitude.

b. A manual comparison of these values to digitized photographs enabling the researcher to choose and correct his area of forecast.

c. A complete list by computer (Program B) of the daily brightness values edited for correlation for June through September of 1967 and 1968, ranging from 45° north latitude to 25° south latitude and 70° east longitude to 180° east longitude.

d. The calculation by computer of the correlation coefficients between the cloud intensity data and the average (weighted) radar index (RI) values for that day.

The overall purpose of this study is to test the feasibility of weather forecasts over Southeast Asia from these brightness values.

TITLE:	Comparison of Tropical Analysis and Hawaiian Winds
AUTHOR:	Murphy, J.
INITIATOR:	Conover, J. (LYS)
ACCOUNT:	4002
PROBLEM:	03
PROJECT:	6698
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	42_8k

A smoothed wind analysis which supplies wind vectors at approximately 5° grid intersections over the tropics is now prepared routinely by the National Weather Service. These winds, referred to as the Tropical Analysis Winds or "T" winds, have considerable potential use in research because they are readily available on tape. However, they are prepared in real time; hence they may suffer by not always including all reports and sometimes including bad reports. A weighting and smoothing program is used to generate the output.

In order to get some idea of how well the machine analysis depicts the wind field, the "T" winds were compared with those read from a hand analysis, which was made by an expert tropical analyst in Hawaii. These winds are known as the Hawaiian or "H" winds. His data was as complete as possible, and the analyst subjectively weeded out bad reports. From these analyses, "H" winds were read for the same grid points as those for which "T" winds were available.

Wind vectors were broken down into u (E-W) and v (N-S) components at each grid point and listed in geographical form for comparison.

Divergence and relative vorticity, important parameters which relate to vertical motion and consequently cloudiness and weather, were also computed from the u and v values. Comparison of all of these parameters, both subjectively and in the form of RMSE's, shows that the "H" winds contain more details of the circulation and consequently more details in the divergence and vorticity patterns. Whether these additional details in the divergence and vorticity patterns are significant in explaining the weather will soon be tested by comparison with satellite-observed cloudiness at all levels.

TITLE: Calculation of Wind Parameter Correlation Coefficients
AUTHOR: Bullock, G.
INITIATOR: Conover, J. (LYS)

ACCOUNT: 4002
PROBLEM: 05
PROJECT: 6698

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 51_8k

Correlation coefficients of four wind parameters, which were computed by the Barnes Analysis program of Number 4002, 4, are calculated with respect to radar indices at Tan Son Nhut, South Vietnam. The four parameters consist of analyzed wind direction, velocity, vorticity and divergence. The output is displayed on a 36-by-36 geographical grid printout.

The purpose of this analysis is to determine from empirical data the origins of the wind circulations that affect precipitation in the area of Tan Son Nhut. The programs developed for this analysis aid the scientist in correlating wind vectors and radar indices.

TITLE: Analysis of Cloud Intensity over India
AUTHOR: Armstrong, D.
INITIATOR: Conover, J. (LYS)

ACCOUNT: 4002
PROBLEM: 06
PROJECT: 6698

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: [illegible]7_8k

Two programs perform correlations between cloud and precipitation data as part of a meteorological study to determine how cloud data in India affects subsequent precipitation. The data period involved is for the months of June through September of 1967 and 1968.

"CREATE" correlates precipitation versus cloud intensity over India for the purpose of testing the feasibility of weather forecasts from cloud brightness values.

"CORREL" determines the correlation coefficients between cloud data and either (1) average precipitation, for all stations reported, or (2) the number of stations reporting precipitation greater than .01, divided by the total number of stations reporting for each of nineteen various areas into which India was divided.

TITLE:	Analysis of Precipitation over India
AUTHOR:	Lawson, V.
INITIATOR:	Conover, J. (LYS)
ACCOUNT:	4002
PROBLEM:	07
PROJECT:	6698
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	45_8k

Precipitation data within six areas of India is correlated for the purpose of improving weather predictions in sections of India. Correlations of two different areas are made between their average precipitation and also between their average number of stations reporting precipitation. Time lags, as well as total number of paired values used in each correlation, are taken into account in the correlations. The time span involved is from 1 June to 30 September for years 1967, 1968 and 1969. In essence, this program displays the relationship of precipitation for two areas and the amount of data used in the support of these resulting correlation coefficients.

TITLE: Geoceiver Data Processing
AUTHOR: Conway, E.
INITIATOR: Hadgigeorge, G. (LWG)

ACCOUNT: 4003
PROBLEM: 01
PROJECT: 7600

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 77_8k

Geoceiver data received from orbiting satellites by various ground stations is processed. The geoceiver data is contained on tape and includes satellite and station numbers, date, positive or negative temperature, pressure, humidity, observation time, offset doppler count and refraction cycle count. Trajectory information is input to interpolate for the satellite position at observation time. The satellite position may be in inertial or earth-fixed reference coordinates.

The station position, slant range at each observation time, the geometric (vacuum) zenith angle at each observation time, the transmission time at each observation time and the time of closest approach for each pass are calculated. Geoceiver clock observation times are corrected and the standard deviation of the clock correction is computed. The ionospheric refraction correction is determined and the corrected doppler count is computed. The corrected time differences, the slant range differences, the tropospheric refraction correction, the tropospheric range difference and the slant range difference corrected for tropospheric refraction, are calculated. Navigation in the satellite plane is determined and the pass direction is computed.

The results are to be used for a man-portable tracking station, which for the first time will be available to aid in the accurate mapping of relatively remote areas. In addition, the doppler data results will be valuable in further refining the mathematics model of the earth's gravity field.

TITLE: Paper Tape Generation for Satellite Laser Ranging Experiment
AUTHOR: Grossman, P.
INITIATOR: Hadgigeorge, G. (LWG)

ACCOUNT: 4003
PROBLEM: 02
PROJECT: 7600

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 50_8k

Two programs generate two paper tapes for controlling the satellite laser ranging instrument. The data is obtained from magnetic tapes supplied by the Smithsonian Astrophysical Observatory. The satellite numbers and observation times of interest are searched for on the tapes, and the selected data is punched to paper tape. One of the paper tapes contains range data and the other contains elevation and azimuth data.

TITLE:	Climatic Aids for Weather Forecasters
AUTHOR:	Abelowitz, A.
INITIATOR:	Lund, I. (LKI)
ACCOUNT:	4004
PROBLEM:	01
PROJECT:	8624
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	55_8k

The purpose of this project was to develop model climatic aids for use by weather forecasters to estimate the probability of future weather events.

Weather observations consisting of surface weather conditions for each hour from August 1942 to March 1969 were recorded on magnetic tapes at Travis AFB, California. Also, hourly observations taken during the period April 1969 through February 1970 were copied onto microfilm.

In addition, 850-mb and 1000-mb height data for 1977 grid points over the Northern Hemisphere were recorded on National Meteorological Center (NMC) tapes twice a day for December 1963; December, January, February 1964-1969; and January, February 1970.

Several programs were written to aid in the extraction of elements, such as precipitation, clouds, fog and wind, which are conditions that restrict military operations, from the tape and microfilm data generated at Travis AFB. Also, height data for approximately 500 grid points was extracted from the NMC tapes and correlated with each weather element taken from the Travis data. The work included the calculation of the frequency distributions of the visibility data and of various amounts of precipitation, and the sorting and tabulation of the Travis and height data.

TITLE:	Cloudiness Probability Determination--Project Columbia
AUTHOR:	Atkinson, J.
INITIATOR:	Lund, I. (LKI)
ACCOUNT:	4004
PROBLEM:	02
PROJECT:	8624
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	75_8k

A series of programs process cloud data to determine the best visibility for photographing terrain from a satellite. One task of this project, called Project Columbia, is to determine the probability of recurrence and persistence of cloudiness in a particular location.

The observed data consists of total sky cover and cloud type observed at 0900, 1200 and 1500 local standard time for the periods 1 March 1966 through 28 February 1969 and 1 June 1969 through 18 September 1969. Tables of clear and cloudy persistence and of clear and cloudy recurrence are constructed to determine the probability that a point will remain clear, or cloudy, for several hours, and that a point will be clear, or cloudy, at some later time if it was clear or cloudy at some initial hour.

TITLE:	Analysis of Soil Moisture Content for Weather Prediction
AUTHOR:	Whelan, L.
INITIATOR:	Lund, I. (LKI)
ACCOUNT:	4004
PROBLEM:	03
PROJECT:	8624
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	50_8k

Soil moisture content data contained on magnetic tape was processed to extract the data for one station (Chiva Chiva) for which other meteorological data exists.

The objective of this stuay is to develop mathematical models for estimating soil moisture from routinely observed meteorological data. If results look promising from the one station, other stations will be studied.

TITLE:	Tape Conversion
AUTHOR:	Meehan, P.
INITIATOR:	Sillars, R. (LKO)
ACCOUNT:	4005
PROBLEM:	01
PROJECT:	6688
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	50_8k

A tape that was created on the IBM 7094 II-7044 DCS is converted to the CDC 6600. The tape was not generated by a Fortran program, and no subroutines existed to convert such a tape, so that a special program was written to perform the conversion.

A binary-formatted magnetic tape containing 101 files, with record lengths of 175 words, is output.

TITLE: Surface Wave Phenomena on Piezoelectric Crystals
AUTHOR: Smith, T.
INITIATOR: Slobodnik, A. (LZM)

ACCOUNT: 4006
PROBLEM: 03
PROJECT: 5635

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 135_8k

An attenuation program "ATTN," that was originally written and modified to study surface wave phenomena on piezoelectric crystals, was reconstructed to operate on the CDC 6600 as the main link in a data generation and retrieval system. From a basic set of parameters describing a particular crystal and orientation, a variety of data is calculated depending on the selected options. The physical configurations considered in the original numerical study included surface wave propagation (1) on a piezoelectric half space in the presence of an infinitesimal electric or "magnetic" conductor located at an arbitrary fixed distance; and on a piezoelectric or pure elastic half space, (2) contiguous to a perfect isotropic elastic conductor of arbitrary thickness, (3) contiguous to a perfect fluid half space, and (4) contiguous to an isotropic elastic layer of arbitrary thickness. The modification to the original implemented a calculation of surface wave attenuation using an expression based on a perturbation analysis and the viscosity tensor which accounts for losses due to the Akheiser mechanism. On the CDC, the program operates in three states: (1) Options Off - complete analysis and output, (2) Metal Film Option and (3) Attenuation Option.

The second link in the system is "UTIL"--the executive utility program incorporating many retrieval functions including those previously serviced by six separate programs. This program accepts tapes created by "ATTN" as input, producing punched cards, plots and printed output in a variety of formats. "UTIL" also sorts, maintains, prints and punches the catalog, recatalogues tapes and prepares blank tapes for use by "ATTN."

TITLE: Bulk Wave in a Crystal
AUTHOR: O'Brien, J.
INITIATOR: Slobodnik, A. (LZM)

ACCOUNT: 4006
PROBLEM: 04
PROJECT: 5635

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 70_8k

The quantities for velocity, strain tensor, stress tensor, power flow vector, and viscosity damping coefficients are computed as a function of orientation (velocity direction) for the three polarizations (longitudinal, fast shear, and slow shear) of a bulk wave in crystal.

If the crystal is piezoelectric, the quantities for electric field, electric displacement vector and change in velocity caused by the piezoelectric effect are also calculated.

Either pen plots or film plots of the tensor components versus angle for all three polarizations for the following parameters may be output:

a. Velocity

b. Percentage change in velocity caused by the piezoelectric effect. This plot is omitted if the crystal is non-piezoelectric.

c. Both power flow angles.

d. Both T1 and T6 stress components in the primed coordinate system.

e. All non-zero viscosity damping coefficients in the crystalline coordinate system.

TITLE:	Determination of Metal Layers' Affects on Surface Wave Substrates
AUTHOR:	Portnoy, A.
INITIATOR:	Slobodnik, A. (LZN)
ACCOUNT:	4006
PROBLEM:	07
PROJECT:	5635
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	210_8k

Program "ATTW" was written to display graphically the output parameters of "ATTN" of Problem Number 4006, 3. The purpose is to determine the effects of metal layers on the propagation characteristics of surface wave substrates. The program aids in the design of long-tapped delay lines and dispersive filters, which are presently under construction at the Air Force Cambridge Research Laboratories in direct support of the Space and Missile Systems Organization (SAMSO) TN 16-70-87.

Three different sets of plots may be output, i.e. angle iteration plots, film thickness plots and depth-into-material and depth-of-film plots.

TITLE:	Surface Wave Characteristics on Crystals
AUTHOR:	Murphy, J.
INITIATOR:	Slobodnik, A. (LZN)
ACCOUNT:	4006
PROBLEM:	09
PROJECT:	5635
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	42_8k

A program was initiated to verify the punched output of two previously written programs, "BULK," of Number 4006, 4, and "UTILITY" of Number 4006, 3. Further analysis of the data is dependent upon the results of this test. Verification is accomplished by plotting and/or printing the data, which contains characteristics of surface waves or various crystals, and comparing the output with the previous programs' output. The five types of data examined are, bulk data, VSI diffraction data, technote data, non-piezoelectric data and piezoelectric data.

TITLE:	Rocket Position Data Generation--Conversion of No. 1236
AUTHOR:	Dieter, K.
INITIATOR:	Robinson, E. (SUYA)
ACCOUNT:	4008
PROBLEM:	01
PROJECT:	0001
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	120_8k

Radar tracking data processed in Number 3525, 1, is input, via magnetic tape to a trajectory program to produce rocket position data. The trajectory program was originally written for the DCS and has been converted under this account/problem number fo the CDC 6600.

The program is designed to evaluate the rectangular (X, Y, Z) components and their derivatives of a missile relative to its launch site, with regard to refraction effects. The program also curve-fits the components, their derivatives, and the altitude values, generating points for the quantities well before and after the observed range of points. Geodetic latitude and longitude are also determined for each of these points.

TITLE:	Modification of Problem Number 1236
AUTHOR:	Williams, N.
INITIATOR:	Robinson, E. (SUYA)
ACCOUNT:	4008
PROBLEM:	02
PROJECT:	0001
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	77_8k

"TRAJ-1" of Problem Number 1236 has been modified to reduce the core requirements.

The program is designed to evaluate the rectangular (X, Y, Z) components and their derivatives of a missile relative to its launch site, taking into account refraction effects. The components, their derivatives and the altitude values are curve-fit, and points are generated for the quantities well befo and after the observed range of points. Geodetic latitude and longitude are a so determined for each of these points.

The output consists of printed and plotted orbital information.

TITLE: GE-625 Computer Tape Conversion
AUTHOR: Atkinson, J.
INITIATOR: Robinson, E. (SUYA)

ACCOUNT: 4008
PROBLEM: 03
PROJECT: 0001

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 42_8k

A data tape created on a GE-625 computer at Wallops Station, Virginia, is converted to the CDC and reformatted.

Rocket trajectory position data is generated from raw radar tracking data received from the rocket launch facility in Virginia. The radar data, consisting of time, azimuth, elevation and slant range, is processed by a trajectory program to compute position, velocity, acceleration, altitude, latitude and longitude.

The reformatted data is output on magnetic tape which will be input to this trajectory program, the output of which consists of magnetic tape containing the pertinent trajectory information and plots.

TITLE: GE-625 Computer Tape Conversion--Modification
AUTHOR: Atkinson, J.
INITIATOR: Robinson, E. (SUYA)

ACCOUNT: 4008
PROBLEM: 03
PROJECT: 0001 MODIFICATION: A

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 42_8k

"RADAR 2" of Problem Number 4008, 3, which converted a GE-625 computer tape containing radar information to the CDC 6600 format, edited the tape, and created a new data tape, has been modified to include the following capabilities:

1) to process multiple file tapes,

2) to process multiple input tapes containing one or more files per tape,

3) to generate one output file for each input file or to generate one output file for more than one input file if the gap in time between input files is less than a specified number,

4) to output seconds from launch time as well as Greenwich Mean Time, azimuth, slant range and elevation.

TITLE: Tape Conversion
AUTHOR: Boudreau, R.
INITIATOR: Robinson, E. (SUYA)

ACCOUNT: 4008
PROBLEM: 04
PROJECT: 0001

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 44_8k

A tape containing rocket position data is converted from the IBM 7094 II-7044 DCS format to the CDC 6600 format for input to "TRAJ-1" of Number 4008, 1. In addition to conversion, the record format and data are modified.

The data consists of time, azimuth, elevation and range. The output consists of the converted tape plus some printed information.

TITLE: Infrasonic Data Processing
AUTHOR: Powell, P.
INITIATOR: Eiff, E. (LWW)

ACCOUNT: 4009
PROBLEM: 01
PROJECT: 7639

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 76_8k

Infrasonic data is read from paper tape and separated by channel. Each channel is scaled and the scaled data is punched onto cards according to specified formats and plotted for each channel at 200 points on the data scale versus 100 or 300 points on the time scale.

Thus, this infrasonic data is placed in a usable form for the study of low-frequency acoustic and acoustic-gravity wave propagation in the atmosphere for the purpose of determining location of signal sources (through cross-correlation and beam steering) and of determining significant signal components and their amplitudes through spectrum analysis.

TITLE:	Synthetic Waveforms
AUTHOR:	Stancik, J.
INITIATOR:	Iliff, E. (LWW)
ACCOUNT:	4009
PROBLEM:	02
PROJECT:	7639
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	150_8k

A program was written to synthesize pressure waveforms of acoustic gravity waves generated by nuclear explosions in the atmosphere. The purpose is to study propagation of nuclear explosion-generated acoustic gravity waves in the atmosphere.

The atmosphere is approximated by a multilayer atmosphere, with constant wind velocity and temperature in each layer. The number of layers, widths of layers, and properties of layers may be selected by the user. The ground is assumed to be flat and rigid, and the uppermost layer of the atmosphere is assumed to be unbounded from above.

The source is specified by its height of burst and energy yield. It is approximated as a point energy source with time dependence conforming to cube root (hydrodynamic) scaling derived from the effects of nuclear weapons.

The observer location may be specified arbitrarily. However, the computation includes only contributions from fully ducted guided modes, and accordingly gives a solution valid (at best) only at large horizontal distances. Also, the programming is based on the premise that only portions of modes with phase velocities greater than the maximum wind's speed are to be included in the computation. Therefore, the program cannot be applied to the study of critical layer effects.

TITLE:	Analysis and Simulation Branch Project/Problem Library
AUTHOR:	Armstrong, D.
INITIATOR:	Almon, A. (SUYA)
ACCOUNT:	4010
PROBLEM:	01
PROJECT:	0001
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	60_8k

Scientific computer programs prepared by the Analysis and Simulation Branch of AFCRL, Hanscom Field, Bedford, Massachusetts, are classified, stored, maintained, updated and retrieved by a system of library programs. Included in this series of programs are programs which create a master file of information about completed computer programs, provide for the capability of retrieving from this Program Library Information File (PLIF) and produce various statistical reports.

TITLE: Project/Problem Library Management and Maintenance Program System
AUTHOR: Guarente, J.
INITIATOR: Almon, A. (SUYA)

ACCOUNT: 4010
PROBLEM: 02
PROJECT: 0001

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 45_8k

Program "CREATE" was written as an independent program used in conjunction with the Analysis and Simulation Branch Project/Problem Library. The ultimate purpose is to tie together the management and maintenance (M&M) programs in the program library system and to decrease the turnaround time of the in-house management reports. The CRT Intercom system is used extensively in this problem.

Two phases are involved. First, the intercom is used interactively to create control and data instructions necessary to execute the M&M programs. Second, the intercom batch mode is employed to send the interactively created private file to the central computer for execution of the desired M&M programs.

TITLE: Ionospheric Total Electron Content Measurements
AUTHOR: Portnoy, A.
INITIATOR: Klobuchar, J. (LIR)

ACCOUNT: 4011
PROBLEM. 01
PROJECT: 4643

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 65_8k

The total electron content (TEC) of the earth's ionosphere is measured from several stations. The TEC is necessary to correct for time delays which any transionospheric radio wave experiences. For instance, a ground-based radar receiving signal from a satellite in orbit will experience a range error because of the additional time required for the radar wave to pass through the earth's ionosphere. This time delay is directly proportional to the total number of electrons through which the radar wave must pass.

Polarization twist data is received on a continuous basis from VHF radio waves, which are viewed from geostationary satellites. This data is converted to equivalent vertical total electron current, and the computer program output is in the form of electrons per square meter column for an equivalent vertical column. Calcomp plots of total electron content are also produced. The results aid ionospheric researchers in correcting for time delays in the radio waves.

TITLE:	Measurement of Earth Tides
AUTHOR:	Grossman, P.
INITIATOR:	Perry, R. (LWG)
ACCOUNT:	4012
PROBLEM:	01
PROJECT:	8607
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	50_8k

Earth tide gravity data is collected on punched paper tape at the rate of one observation per minute. Four programs were written to convert this data to magnetic tape and to establish and maintain a magnetic tape library of the data.

The programs perform the following functions:

a. The data on the paper tape is placed on magnetic tape.

b. The data on the magnetic tape is edited by deletion, change, or addition of records, which are output on another magnetic tape.

c. A new master gravity data tape is created from either the updated tape or the updated tape and the old master tape.

d. The gravity data is accumulated for one hour and output as one physical record.

The resulting specially formatted tapes will be required for various users of the data in the measurement of earth tides.

TITLE:	Riometer Data Reduction
AUTHOR:	O'Brien, J.
INITIATOR:	Cormier, R. (LII)
ACCOUNT:	4016
PROBLEM:	01
PROJECT:	5631
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	77_8k

Two programs "ABSM" and "PLOTTT," written under Problem No. 1367 for the IBM 7094-7044 DCS, have been converted to the CDC 6600. These programs are used for reduction of riometer data.

"ABSM" computes the absorption of radio noise from our galaxy, the Milky Way, by the earth's ionosphere as a function of time. The received intensity (digitized from graphs and put on tape) is compared with the quiet-day curve (punched on cards). The computed absorption is output on the printer and on tape.

The output tape of "ABSM" is input to "DRAW" (formerly "PLOTTT") which generates the absorption curve on a Calcomp plot.

TITLE:	Cannonball and Musketball Satellite Data Plots
AUTHOR:	Dieter, K.
INITIATOR:	Schweinfurth, R. (LKB)
ACCOUNT:	4017
PROBLEM:	1
PROJECT:	6690
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	50_8k

Data gathered from two satellites "Cannonball" and "Musketball," is evaluated. The data is input on cards, and the month, day and year for each latitude and altitude value are determined. The weekly and monthly results are plotted with altitude versus time and latitude versus time. If the range of data is less than one week, only the summary (monthly) plotting is done.

The program may be applied to data from many other satellites, provided the number of data points does not exceed 500.

TITLE:	Cannonball-Musketball Satellite Data Plot Modification
AUTHOR:	Dieter, K.
INITIATOR:	Schweinfurth, R. (LKB)
ACCOUNT:	4017
PROBLEM:	02
PROJECT:	6690
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	55_8k

The Cannonball-Musketball Satellite program, written under Account/Problem Number 4017, 1, has been extended to plot density values versus altitude, as well as the weekly and monthly results. The weighted altitude is plotted versus time, a curve-fit is generated. The basic purpose, which is to compare observational data with the most recent (1971) Jacchia model, has been unchanged.

TITLE:	Solar Burst Data Processing
AUTHOR:	Whelan, L.
INITIATOR:	Barron, W. (LIR)
ACCOUNT:	4018
PROBLEM:	01
PROJECT:	4613
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	50_8k

Solar burst data is edited, sorted on frequency and event type, analyzed statistically and printed.

The results of the program will provide insight into the average spectral characteristics of solar radio bursts and the variability of these characteristics. The output will show the way the observed burst spectrum changes as the sun progresses through its cycle of activity. These pieces of information may then be used in conjunction with other observed terrestrial and space phenomena to derive further and better knowledge of the sun and its environment, which encompasses the earth, its magnetic field and its ionosphere.

TITLE:	Digitized Ionospheric Data Check
AUTHOR:	Dieter, K.
INITIATOR:	Toman, K. (LII)
ACCOUNT:	4019
PROBLEM:	01
PROJECT:	5631
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	50_8k

Ionospheric data, originally on analog tape, was put on film by means of a photographic process, and the prints from the film were digitized. The digitized data was placed on paper tape and then on magnetic tape.

Program "CHECK" was written to unpack the data, consisting of time, frequency, spacing and amplitude, from the magnetic tape and to plot the results for a visual comparison with the original data on the prints. The purpose is to assay the faithfulness of the digitizing process.

TITLE:	Atmospheric Optical Attenuation Model
AUTHOR:	Dieter, K.
INITIATOR:	Elterman, L. (OPA)
ACCOUNT:	4020
PROBLEM:	01
PROJECT:	7621
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	50_8k

Two programs, "MODATM" and "NEWMA," compute optical attenuation coefficients and optical thicknesses as functions of wavelength and altitude for a model of a clear standard atmosphere in the ultraviolet, visible and infrared regions.

The programs differ only in the method of numerical integration used to perform the calculations. "MODATM" uses trapezoidal integration, and "NEWMA" uses the new, more accurate method of decaying exponentials.

A third program, "ATMPLT," produces Calcomp plots of the model atmosphere parameters, which were output from either "MODATM" or "NEWMA." These plots consist of index of refraction, Rayleigh scattering cross-section, aerosol scattering cross-section, and Vigroux ozone absorption coefficient, all versus wavelength, plus atmospheric number density, aerosol number density and ozone concentration (linear and log scale), all versus altitude.

TITLE:	Astrodata Tape Unpack
AUTHOR:	Arsenault, R.
INITIATOR:	McInerney, R. (SUYA)
ACCOUNT:	4501
PROBLEM:	01
PROJECT:	0001
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	42_8k

A subroutine was written to unpack one frame of data each time the subroutine is called. The input data to this routine is contained on a tape from the Astrodata digitizing system.

This subroutine satisfies the need for a general-purpose unpacking routine. The number of channels to be unpacked is automatically unpacked, the two's complement 12-bit Astrodata words are converted to the CDC 6600 format, time jumps are converted, records can be read or skipped when required, and partial or invalid data samples can be omitted.

TITLE: Cannonball II Telemetry Data Processing
AUTHOR: Connors, E.
INITIATOR: Champion, K. (LKB)

ACCOUNT: 4503
PROBLEM: 02
PROJECT: 6690

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 55_8k

Three programs were written to support the analysis of experimental data from the OAR-901 satellite (Cannonball II). The OAR-901 Merge Program, "MRGE901," uses raw digital tapes as input and satellite clock and range time information as references to: (1) associate a Greenwich Mean Time (GMT) to each frame of experiment and engineering commutator data; (2) merge an orbit of experiment commutator data with an orbit of engineering commutator data; (3) merge this data with satellite ephemeris data produced by the Orbital Determination Group; and (4) store this information on a binary tape for use by experiment analysts.

The OAR-901 Quality Check Program checks the tape and data quality of digital computer tapes created from NASA instrumentation tapes containing real-time and tape-recorder data as recorded from the OAR-901 satellite. This check enables the data then to be merged with satellite ephemeris and aspect data, creating merged data/ephemeris/aspect tapes used by the researcher in the reduction of experimental data.

The OAR-901 magnetometer plot program was written to support the analysis of experimental data from the OAR-901 satellite by validating the merge of the OAR-901 satellite ephemeris data tapes with the OAR-901 data tapes. The validation is done by producing Calcomp plots and a computer listing, which compare theoretical magnetic field data with magnetic field data measured by satellite sensors, and which compare theoretical sun/shade information with satellite-measured sun-sensor data.

TITLE: Gerdien Condensor for Rocket Number AJ17.757
AUTHOR: Delorey, D.
INITIATOR: Conley, T. (LIJ)

ACCOUNT: 4505
PROBLEM: 01
PROJECT: 7663

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 115_8k

The Gerdien Condensor is a conductivity probe flown aboard sounding rockets that consists of two electrodes arranged in the geometry of a coaxial cylinder. One electrode is called the collector, and the other the driving electrode.

The ultimate purpose of the Gerdien Condensor detector is to obtain measurements of positive ion density and mobility for altitudes below 70 km.

Since the purpose of the detector is to make positive ion measurements, the driving electrode is swept positive from zero volts.

A program was written to calculate positive ion density and mobility and produce plots of ion current as a function of sweep voltage for Rocket Number AJ17.757.

TITLE: Gerdien Condensor for Rocket No. AJ17.906-1
AUTHOR: Delorey, D.
INITIATOR: Conley, T. (LIJ)

ACCOUNT: 4505
PROBLEM: 02
PROJECT: 7663

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 115_8k

The Gerdien Condensor is a conductivity probe flown aboard sounding rockets that consists of two electrodes arranged in the geometry of a coaxial cylinder. One electrode is called the collector, and the other the driving electrode.

The ultimate purpose of the Gerdien Condensor detector is to obtain measurements of positive ion density and mobility for altitudes below 70 km.

Since the purpose of the detector is to make positive ion measurements, the driving electrode is swept positive from zero volts.

A program was written to calculate positive ion density and mobility and produce plots of ion current as a function of sweep voltage for Rocket No. AJ17.906-1.

TITLE: Gerdien Condensor for Rocket No. AJ17.617
AUTHOR: Delorey, D.
INITIATOR: Conley, T. (LIJ)

ACCOUNT: 4505
PROBLEM: 03
PROJECT: 7663

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 115_8k

The Gerdien Condensor is a conductivity probe flown aboard sounding rockets that consists of two electrodes arranged in the geometry of a coaxial cylinder. One electrode is called the collector, and the other the driving electrode.

The ultimate purpose of the Gerdien Condensor detector is to obtain measurements of positive ion density and mobility for altitudes below 70 km.

Since the purpose of the detector is to make positive ion measurements, the driving electrode is swept positive from zero volts.

A program was written to calculate positive ion density and mobility and produce plots of ion current as a function of sweep voltage for Rocket No. AJ17.617.

TITLE: Gerdien Condensor for Rocket No. AJ17.758
AUTHOR: Delorey, D.
INITIATOR: Conley, T. (LIJ)

ACCOUNT: 4505
PROBLEM: 04
PROJECT: 7663

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 115_8k

The Gerdien Condensor is a conductivity probe flown aboard sounding rockets that consists of two electrodes arranged in the geometry of a coaxial cylinder. One electrode is called the collector, and the other the driving electrode.

The ultimate purpose of the Gerdien Condensor detector is to obtain measurements of positive ion density and mobility for altitudes below 70 km.

Since the purpose of the detector is to make positive ion measurements, the driving electrode is swept positive from zero volts.

A program was written to calculate positive ion density and mobility and produce plots of ion current as a function of sweep voltage for Rocket No. AJ17.758.

TITLE:	Gerdien Condensor for Rocket No. AJ17.602
AUTHOR:	Delorey, D.
INITIATOR:	Conley, T. (LIJ)
ACCOUNT:	4505
PROBLEM:	05
PROJECT:	7663
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	115_8k

The Gerdien Condensor is a conductivity probe flown aboard sounding rockets that consists of two electrodes arranged in the geometry of a coaxial cylinder. One electrode is called the collector, and the other the driving electrode.

The ultimate purpose of the Gerdien Condensor detector is to obtain measurements of positive ion density and mobility for altitudes below 70 km.

Since the purpose of the detector is to make positive ion measurements, the driving electrode is swept positive from zero volts.

A program was written to calculate positive ion density and mobility and produce plots of ion current as a function of sweep voltage for Rocket No. AJ17.602.

TITLE:	Gerdien Condensor for Rocket No. AJ17.750
AUTHOR:	Delorey, D.
INITIATOR:	Conley, T. (LIJ)
ACCOUNT:	4505
PROBLEM:	06
PROJECT:	7663
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	115_8k

The Gerdien Condensor is a conductivity probe flown aboard sounding rockets that consists of two electrodes arranged in the geometry of a coaxial cylinder. One electrode is called the collector, and the other the driving electrode.

The ultimate purpose of the Gerdien Condensor detector is to obtain measurements of positive ion density and mobility for altitudes below 70 km.

Since the purpose of the detector is to make positive ion measurements, the driving electrode is swept positive from zero volts.

A program was written to calculate positive ion density and mobility and produce plots of ion current as a function of sweep voltage for Rocket AJ17.750.

TITLE: Interactive Graphics General Editing
AUTHOR: Carbone, J.
INITIATOR: Grieder, W. (LIJ)

ACCOUNT: 4506
PROBLEM: 06
PROJECT: 7663

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 47_8k

"AUTOEDIT" is a general-purpose graphics program that enables the user to display, analyze, and edit a file of data interactively.

The program enables the user to,

1) fit polynomial curves to a set of data points, add points to a display, delete points from a display and data base, smooth portions of the data, and perform varied display-oriented functions.

2) choose X and Y values from the input record.

3) define interactively the limits for each subset of the data base.

4) create a new data file in the same format as the original file.

5) examine a selected portion of the entire data file.

6) obtain CRT plots of selected portions of the data file.

The test case involved electron density data. The printed output varies according to the user's mode of operation. Permanent files containing edited data files and/or CRT plots are optional.

TITLE: Electrostatic Probe on Rocket AD21.862
AUTHOR: Delorey, D.
INITIATOR: Hayes, D. (LZP)

ACCOUNT: 4507
PROBLEM: 01
PROJECT: 4642

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 70_8k

A study into techniques for improving the transmission and reception of radio signals from aerospace vehicles during re-entry into the earth's atmosphere is being made. A complete blackout of telemetry can be caused by the plasma sheath which surrounds the vehicle during this stage of the trajectory. A solution to this problem may be found through the measurement of plasma sheath properties and their effect on the transmission and reception of radio signals.

Program "LISTT" plots and lists electrostatic probe data from segments of three commutators during the re-entry phase of rocket flight AD21.862.

TITLE:	OV1-21 Data Reduction
AUTHOR:	Auclair, C.
INITIATOR:	Philbrick, C. (LKD)
ACCOUNT:	4514
PROBLEM:	09
PROJECT:	6687
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	57_8k

Four programs perform reduction of OV1-21 data. First, OV1-21 satellite data tape is unpacked; all partial and obviously erroneous commutator frames are eliminated; a GMT is associated with the remaining complete frames; these frames are output onto a binary tape; and satellite health and experiment status information is listed.

Then the reformatted OV1-21 satellite ephemeris data is merged with the OV1-21 experimental data, and the merged data is output onto tape for use by the experimenter in the reduction and analysis of his experimental data.

Next, the time difference between the satellite clock values and GMT for those commutator frames that have a GMT associated with them is computed, and the commutator rates for those frames are calculated also. Since the OV1-21 digital tape format associates a GMT with (at best) only one of five commutator frames, this program uses the satellite clock to calculate the GMT of each frame.

Finally, the merge of the OV1-21 satellite ephemeris data tapes with the OV1-21 satellite reformatted data tapes is validated by comparing plots and printing of (1) theoretical magnetic field data with magnetic field data measured by satellite sensors and (2) theoretical sun/shade information with satellite sun sensor data. Also, raw aspect information is listed for use by aspect analysts.

TITLE:	OV3-6 Data Merge
AUTHOR:	Atkinson, J.
INITIATOR:	Philbrick, C. (LKD)
ACCOUNT:	4514
PROBLEM:	10
PROJECT:	6687
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	42_8k

OV3-6 series tapes are merged onto an 800 BPI output tape. Program "OVPACK" is capable of copying up to four tapes, each with 39 files, onto one output tape.

Only files which have correctly formatted data and at least one non-header record are copied. All other files are skipped, and an appropriate message is printed on the output listing. Also, individual records which are incorrectly formatted are skipped, and another message is printed.

The purpose is to set up the OV3-6 data for future processing.

TITLE:	Brightness and Direction of Visible Objects in Space
AUTHOR:	Trent, P.
INITIATOR:	Price, S. (OPI)
ACCOUNT:	4515
PROBLEM:	01
PROJECT:	8692
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	55_8k

The purpose of this program is to compute the brightness and direction in space of visible objects (e.g., stars) that were sensed by rocket A04.004-2.

The rocket flight time is divided into periods called rolls. The 24 sensors on the rocket are called channels.

For each pulse recorded on a sensor, the program computes the brightness, azimuth and zenith using a set of constants associated with each channel and a set of constants associated with each roll. The time, pulse height, channel number, azimuth, zenith, right ascension and declination are printed and output on tape.

TITLE: Project HI-STAR, Detected Sources Pos'tion Update
AUTHOR: Trent, P.
INITIATOR: Price, S. (OPI)

ACCOUNT: 4515
PROBLEM: 02
PROJECT: 8692

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 65_8k

A star catalog was compared with a list of observed peaks containing the azimuth and zenith of visible objects that were sensed by rocket A04.004-2. This enabled a test of rocket performance.

For each revolution (roll) of the rocket the program prints all peaks that were observed during the roll and all entries in the star catalog whose azimuth and zenith were reasonably close to an observed peak of the roll. In addition, for those peaks that have matches in the star catalog, the program computes the average and standard deviation of the differences between the azimuth and the zenith at an observed peak, and the azimuth and the zenith of the matching entry in the star catalog.

TITLE: Ampullaceous Probe for Rocket AJ17.906-1
AUTHOR: Delorey, D.
INITIATOR: Sandock, J. (LIJ)

ACCOUNT: 4517
PROBLEM: 01
PROJECT: 7663

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 77_8k

The ampullaceous probe is an instrument designed to measure ionospheric positive ion current, and temperature and vehicle potential. The probe consists of an aperture grid (V_a). a retarding grid (V_r), an auxiliary grid (V_o) and a cathode (V_k). The aperture grid was stepped in $.25_v$ increments for seven levels, chosen to be either side of vehicle potential, and an eighth step at -10.15_v. The grid was maintained at each level for approximately 0.2 seconds or two V_r sweeps. The V_r grid was swept linearly at $V_a \pm 2.4$v. The V_o grid was held at 12 volts more negative than the cathode for suppression of secondary electrons. Program "AMPPRE" uses ampullaceous probe telemetry voltages as input and calculates saturation and secondary ion current, ion temperature and vehicle potential for each of the eight aperture grid levels and retarding grid sweeps by means of linear interpolation in the current vs telemetry voltage calibration curve. If the telemetry voltages representing saturation and secondary current differ by more than one telemetry volt, ion temperature and vehicle potential are calculated using formulas involving the slope of the current-voltage characteristic curve. Output consists of plots and listings.

TITLE:	Langmuir Probe--Rocket No. AJ17.617
AUTHOR:	Delorey, D.
INITIATOR:	Ulwick, J. (LIJ)
ACCOUNT:	4520
PROBLEM:	01
PROJECT:	7663
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	110_8k

Electron and positive ion current are calculated as a function of time and altitude.

The Langmuir probe operates by applying a programmed voltage to an electrode, which is immersed in a plasma, and then measuring the currents which flow in the electrode. An analysis of the resulting current-to-voltage relationships provides information directly related to electron density, temperature, and positive ion density.

The input, consisting of raw data from Rocket No. AJ17.617 is stored in binary on magnetic tape. The data words represent time (in seconds after launch) and telemetry voltages corresponding to the sweep voltage channel, positive ion current channel and electron current channel.

The telemetry voltages from the sweep voltage channel are converted to true sweep voltage, and values of current are calculated whenever the probe voltage is -9v, -3v or +3v. Rocket altitude is also calculated.

The output data is listed in BCD and stored on binary tape. This data consists of time, altitude, probe voltage and current. Currents, as functions of time and altitude, are also plotted.

TITLE: Langmuir Probe--Rocket No. AJ17.906-1
AUTHOR: Delorey, D.
INITIATOR: Ulwick, J. (LIJ)

ACCOUNT: 4520
PROBLEM: 02
PROJECT: 7663

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 110_8k

Electron and positive ion current are calculated as a function of time and altitude.

The Langmuir probe operates by applying a programmed voltage to an electrode, which is immersed in a plasma, and then measuring the currents which flow in the electrode. An analysis of the resulting current-to-voltage relationships provides information directly related to electron density, temperature, and positive ion density.

The input, consisting of raw data from Rocket No. AJ17.906-1 is stored in binary on magnetic tape. The data words represent time (in seconds after launch) and telemetry voltages corresponding to the sweep voltage channel, positive ion current channel and electron current channel.

The telemetry voltages from the sweep voltage channel are converted to true sweep voltage, and values of current are calculated whenever the probe voltage is -9v, -3v or +3v. Rocket altitude is also calculated.

The output data is listed in BCD and stored on binary tape. This data consists of time, altitude, probe voltage and current. Currents, as functions of time and altitude, are also plotted.

TITLE: Langmuir Probe--Rocket No. AJ17.602
AUTHOR: Delorey, D.
INITIATOR: Ulwick, J. (LIJ)

ACCOUNT: 4520
PROBLEM: 03
PROJECT: 7663

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 110_8k

Electron and positive ion current are calculated as a function of time and altitude.

The Langmuir probe operates by applying a programmed voltage to an electrode, which is immersed in a plasma, and then measuring the currents which flow in the electrode. An analysis of the resulting current-to-voltage relationships provides information directly related to electron density, temperature, and positive ion density.

The input, consisting of raw data from Rocket No. AJ17.602 is stored in binary on magnetic tape. The data words represent time (in seconds after launch) and telemetry voltages corresponding to the sweep voltage channel, positive ion current channel and electron current channel.

The telemetry voltages from the sweep voltage channel are converted to true sweep voltage, and values of current are calculated whenever the probe voltage is -9v, -3v or +3v. Rocket altitude is also calculated.

The output data is listed in BCD and stored on binary tape. This data consists of time, altitude, probe voltage and current. Currents, as functions of time and altitude, are also plotted.

TITLE: Langmuir Probe--Rocket No. AJ17.758
AUTHOR: Delorey. D.
INITIATOR: Ulwick, J. (LIJ)

ACCOUNT: 4520
PROBLEM: 04
PROJECT: 7663

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 110_8k

Electron and positive ion current are calculated as a function of time and altitude.

The Langmuir probe operates by applying a programmed voltage to an electrode, which is immersed in a plasma, and then measuring the currents which flow in the electrode. An analysis of the resulting current-to-voltage relationships provides information directly related to electron density, temperature, and positive ion density.

The input, consisting of raw data from Rocket No. AJ17.758 is stored in binary on magnetic tape. The data words represent time (in seconds after launch) and telemetry voltages corresponding to the sweep voltage channel, positive ion current channel and electron current channel.

The telemetry voltages from the sweep voltage channel are converted to true sweep voltage, and values of current are calculated whenever the probe voltage is -9v, -3v or +3v. Rocket altitude is also calculated.

The output data is listed in BCD and stored on binary tape. This data consists of time, altitude, probe voltage and current. Currents, as functions of time and altitude, are also plotted.

TITLE:	Langmuir Probe--Rocket No. AJ17.616
AUTHOR:	Delorey, D.
INITIATOR:	Ulwick, J. (LIJ)
ACCOUNT:	4520
PROBLEM:	05
PROJECT:	7663
HARDWARE/SOFTWARE:	CDC 6600/Fortran IV
MINIMUM CORE SIZE:	110_8k

Electron and positive ion current are calculated as a function of time and altitude.

The Langmuir probe operates by applying a programmed voltage to an electrode, which is immersed in a plasma, and then measuring the currents which flow in the electrode. An analysis of the resulting current-to-voltage relationships provides information directly related to electron density, temperature, and positive ion density.

The input, consisting of raw data from Rocket No. AJ17.616 is stored in binary on magnetic tape. The data words represent time (in seconds after launch) and telemetry voltages corresponding to the sweep voltage channel, positive ion current channel and electron current channel.

The telemetry voltages from the sweep voltage channel are converted to true sweep voltage, and values of current are calculated whenever the probe voltage is -9v, -3v or +3v. Rocket altitude is also calculated.

The output data is listed in BCD and stored on binary tape. This data consists of time, altitude, probe voltage and current. Currents, as functions of time and altitude, are also plotted.

TITLE: Scintillator Probe
AUTHOR: Delorey, D.
INITIATOR: Ulwick, J. (LIJ)

ACCOUNT: 4520
PROBLEM: 06
PROJECT: 7663

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 65_8k

The energy deposition scintillator, which is flown aboard sounding rockets, is designed to measure the total power density carried by electrons and protons. The output of the instrument is a measurement of the rate of energy deposition for particles having energies greater than a predetermined threshold.

For the data from rockets Aj17.602 and AJ17.616, program "SCINT" calculates the values of the power density from telemetry voltages representing power density by means of linear interpolation in a telemetry voltage versus power density calibration table. Output consists of time, power density, altitude and a plot of power density versus time.

TITLE: Proton Detector Magnetic Pitch Angle for Rocket No. AJ17.617
AUTHOR: Delorey, D.
INITIATOR: Ulwick, J. (LIJ)

ACCOUNT: 4520
PROBLEM: 07
PROJECT: 7663

HARDWARE/SOFTWARE: CDC 6600/Fortran IV
MINIMUM CORE SIZE: 65_8k

The correction interpretation of rocket experiment data frequently requires knowledge of the angle between a particular probe and the magnetic field vector. This angle is commonly called the magnetic pitch angle. Program "PAN" calculates the angle between the proton detector and the magnetic field from formulas involving the azimuth and elevation of the detector, using data from Rocket Number AJ17.617.